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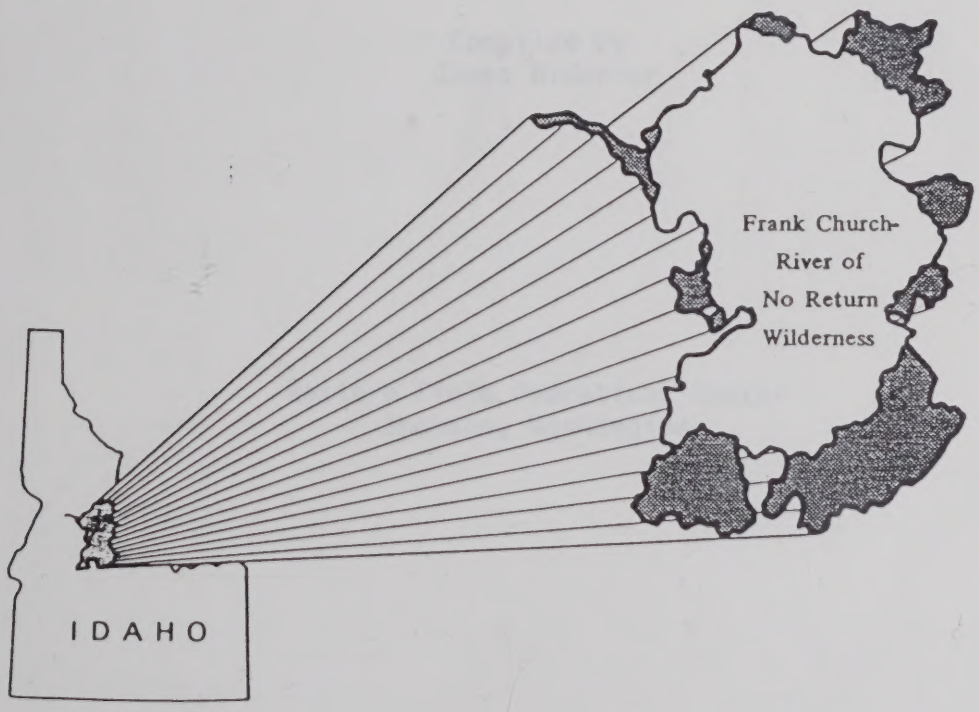
Open File Report

Mineral Resources and Occurrences in part of the Frank Church-River of No Return Wilderness, Custer, Idaho, Lemhi, and Valley Counties, Idaho



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UNITED STATES DEPARTMENT OF THE INTERIOR

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MINERAL RESOURCES AND OCCURRENCES IN PART OF THE FRANK CHURCH-RIVER OF NO RETURN WILDERNESS, CUSTER, IDAHO, LEMHI, AND VALLEY COUNTIES, IDAHO

Compiled by
James Ridenour

Western Field Operations Center
Spokane, Washington

UNITED STATES DEPARTMENT OF THE INTERIOR
Donald P. Hodel, Secretary

BUREAU OF MINES
Robert C. Horton, Director

PREFACE

Under the provisions of The Wilderness Act (Public Law 88-577, September 3, 1964) and the Joint Conference on Senate Bill 4, 88th Congress, the U.S. Geological Survey and the U.S. Bureau of Mines have been conducting mineral surveys of wilderness and primitive areas. Areas officially designated as "wilderness," "wild," or "canoe" when the act was passed were incorporated into the National Wilderness Preservation System, and some of them are presently being studied. The act provides that areas under consideration for wilderness designation should be studied for suitability for incorporation into the Wilderness System. The mineral surveys constitute one aspect of the suitability studies. The act directs that the results of such surveys are to be made available to the public and be submitted to the President and the Congress. This report discusses the results of a mineral survey of the Frank Church-River of No Return Wilderness, Bitterroot, Boise, Challis, Nez Perce, Payette, and Salmon National Forests, Custer, Idaho, Lemhi, and Valley Counties, Idaho. The Wilderness, established by Public Law 96-312 (July 23, 1980), was renamed in honor of Frank Church by Public Law 98-231 (March 14, 1984).

This open-file report will be summarized in joint reports published by the U.S. Geological Survey. The data were gathered and interpreted by Bureau of Mines personnel from Western Field Operations Center, East 360 Third Avenue, Spokane, WA 99202. The report has been edited by members of the Branch of Mineral Land Assessment at the field center and reviewed at the Division of Mineral Land Assessment, Washington, DC.

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SUMMARY

The Frank Church-River of No Return Wilderness, encompassing approximately 2.2 million acres of the rugged, remote region of Custer, Idaho, Lemhi and Valley Counties in central Idaho, includes the former Idaho and Salmon River Breaks Primitive Areas and the former Clear Creek-Upper Big Deer Creek area. The Central Idaho Wilderness Act of 1980 added an estimated 660,000 acres, composed of ten separate parcels of land, to the original areas named above. Mines, prospects, and mineralized areas in and adjacent to the ten parcels (or units) were examined by the U.S. Bureau of Mines in 1981, 1982, and 1983 and are the subject of this report.

The Wilderness and much of the surrounding region is one of the more heavily mineralized regions of Idaho, as indicated by its proximity to 26 mining districts. The main commodities of interest have been gold and silver, but copper, cobalt, antimony, tungsten, mercury, lead, zinc, fluorspar, and uranium have been recovered from lodes, and gold and rare-earth-element-bearing minerals have been mined from placers in central Idaho. Commodities of interest in the subject areas of this report are gold, silver, cobalt, copper, lead, zinc, fluorspar, and zeolites.

Regardless of the commodity present at a given site, those mines, prospects, mining claims, and mineralized areas within the Wilderness are far less likely than those outside the Wilderness to be future exploration targets or to be developed because of the restrictions imposed on such activities by The Wilderness Act (Public Law 88-577, Sept. 3, 1964) and The Central Idaho Wilderness Act (Public Law 96-312, July 23, 1980). This is particularly true of placers, mineralized areas, and other sites not actively claimed by December 31, 1983. The following summarizes the assessment of mineral resources by units.

There are no apparent mineral resources in the Middle Bargamin Creek and Big Mallard Creek units in the northern part of the Wilderness. No lode mineral resources were identified in the Magruder-Blue Joint unit, in the northeastern part of the Wilderness; the low gold content of placer claims that border the south side of the unit indicates that these are presently (1984) classified as occurrences and are not likely to be economic in the foreseeable future.

The strategic and critical commodities, cobalt and copper, occur in Elkhorn Creek and may be present in other areas underlain by similar rocks in the Special Mining Management Zone--Clear Creek.

The Comeback (Lead Star) Mine in the Yellowjacket unit on the east side of the Wilderness may have resources containing gold, silver, and base metals based on a history of past production of these commodities. Analyses of samples from the Jaybird Prospect indicate the site warrants further study as a silver prospect. Rare-earth-element-bearing placers have also been reported in the Yellowjacket unit, but these are small, low grade, and not likely to be commercial in the foreseeable future.

The Lost Packer Mine, abutting the Wilderness in the Loon Creek-Warm Springs Creek unit, is currently (1984) undergoing exploration to determine the extent of a vein discovered by drilling in 1979. Current estimates are that the exploration phase could continue through 1990. Production from this mine is contingent upon development of sufficient reserves to pay back the capital investment of exploration, development, and mining/milling costs. Low-level gold and silver geochemical anomalies detected by soil sampling at the Monte Cristo Mine indicate that additional work is necessary to further confirm the presence or absence of the vein system that was once exposed by adits currently (1983) caved. Commodities of importance at this site are silver and gold.

Elsewhere in the unit are placer deposits on Loon Creek both within and partly within the Wilderness. Inferred, marginally economic placer gold reserves (at a gold price of $400/troy ounce) are at Double Bar and Tin Cup Bar within the Wilderness and at West Tin Cup Bar partly within the Wilderness. Casto Bar, outside the Wilderness, has inferred subeconomic placer gold resources. Large volumes of subeconomic placer gravel occur partly within the Wilderness along Loon Creek road. Their future development is contingent upon a systematic exploration program to determine areas of possible higher concentrations of gold as well as a favorable gold price. Several widespread zeolitized tuff occurrences were sampled to determine the type and concentration of zeolites. Initial results indicate some samples contain as much as 55% zeolites and these and other sites in the unit should be further tested for quantity and quality of zeolite content. Rock containing 40% to 60% total zeolite content can be used as a general soil conditioner. Fluorspar veins in the Wilderness at Meyers Cove are small and largely unexplored. It is unlikely that these will become exploration targets in the foreseeable future.

The southern boundary of the Upper Middle Fork unit adjoins the lower reaches of Bear Valley, a known area of rare-earth-element-bearing placers. Areas adjacent to Bear Valley, mainly in Elk Creek drainage and in Ayers and Poker Meadows, may contain additional resources, but the exploration and development of these placers is prohibited not only by the Central Idaho Wilderness Act, but also by numerous administrative withdrawals. Of four bars on the Middle Fork Salmon River tested for gold content, only Joe Bump Bar was found to contain inferred subeconomic resources. Because these bars are wholly within the Wilderness, further exploration and/or development is prohibited. The Snowslide claim and three nearby, unnamed prospects near the Middle Fork Salmon River, and the Old Soldier Claims inside the Wilderness warrant further study on the basis of favorable gold and silver assays. The Josephus Silver Claim and the Float Creek Mine adjacent to the Wilderness may be future exploration targets because of gold and silver assays.

Gold and silver resources may be present at the Palmetto claim, adjacent to the Wilderness, and at an area south of Rainbow Peak within the Pinacles-Rainbow Peak unit on the western boundary of the Wilderness. These assumptions are based on analytical results and suggest further exploration is warranted.

No lode resources were identified in the Salmon River and Cove Mountain units, but Elk, Bull, Indian, and Warren Creek Bars on the Salmon River contain subeconomic placer gold resources at a gold price of $400/troy oz.

OVERVIEW OF MINERAL OCCURRENCES IN THE FRANK CHURCH-RIVER OF NO RETURN WILDERNESS AND SURROUNDING REGION, CENTRAL IDAHO

by

James Ridenour

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INTRODUCTION

The Frank Church-River of No Return Wilderness occupies a large portion of the sparsely-populated, mountainous region of central Idaho, encompassing parts of Custer, Idaho, Lemhi, and Valley Counties (fig. 1). The Wilderness, created by The Central Idaho Wilderness Act of 1980 (Public Law 96-312, July 23, 1980), consists of approximately 2,239,000 acres of National Forest lands. It includes the former Idaho and Salmon River Breaks Primitive Areas, and the former Clear Creek-Upper Big Deer Creek Area contiguous to the Idaho Primitive Area. Areas not previously studied for their resource potential (fig. 2) total approximately 660,000 acres and are the subject of this report. Also included is a re-evaluation of the Special Mining Management Zone--Clear Creek, originally part of the former Clear Creek-Upper Big Deer Creek Area.

Summary results of this and similar investigations are made public through U.S. Bureau of Mines and U.S. Geological Survey publications. Such data help Congress and other federal agencies make decisions affecting the use of public lands. The information presented in this report will be summarized in U.S. Geological Survey publications on the component areas of the Wilderness.

Setting

The entire Wilderness is rugged and mountainous with elevations ranging from about 2,000 ft above sea level along the Salmon River to the northwest, to more than 10,000 ft in the mountains along the southern boundary. The upper reaches of streams draining the higher elevations exhibit the typical U-shape of glaciated valleys. Except at elevations generally above 9,000 ft and lower areas underlain by extrusive igneous rocks, most areas are heavily to moderately covered by stands of evergreen trees. Some drainages support dense stands of deciduous trees, particularly aspen.

Major vehicle routes surround the Wilderness, connecting the population centers of Boise, Grangeville, Salmon, and Challis, Idaho, and Missoula, Montana (fig. 1). A network of seasonal, graded roads leading into the Wilderness from these highways can be traversed by two-wheel drive vehicles during the summer months and require four-wheel drive capability during May and June, and from mid-September until they are blocked by heavy snowfall.

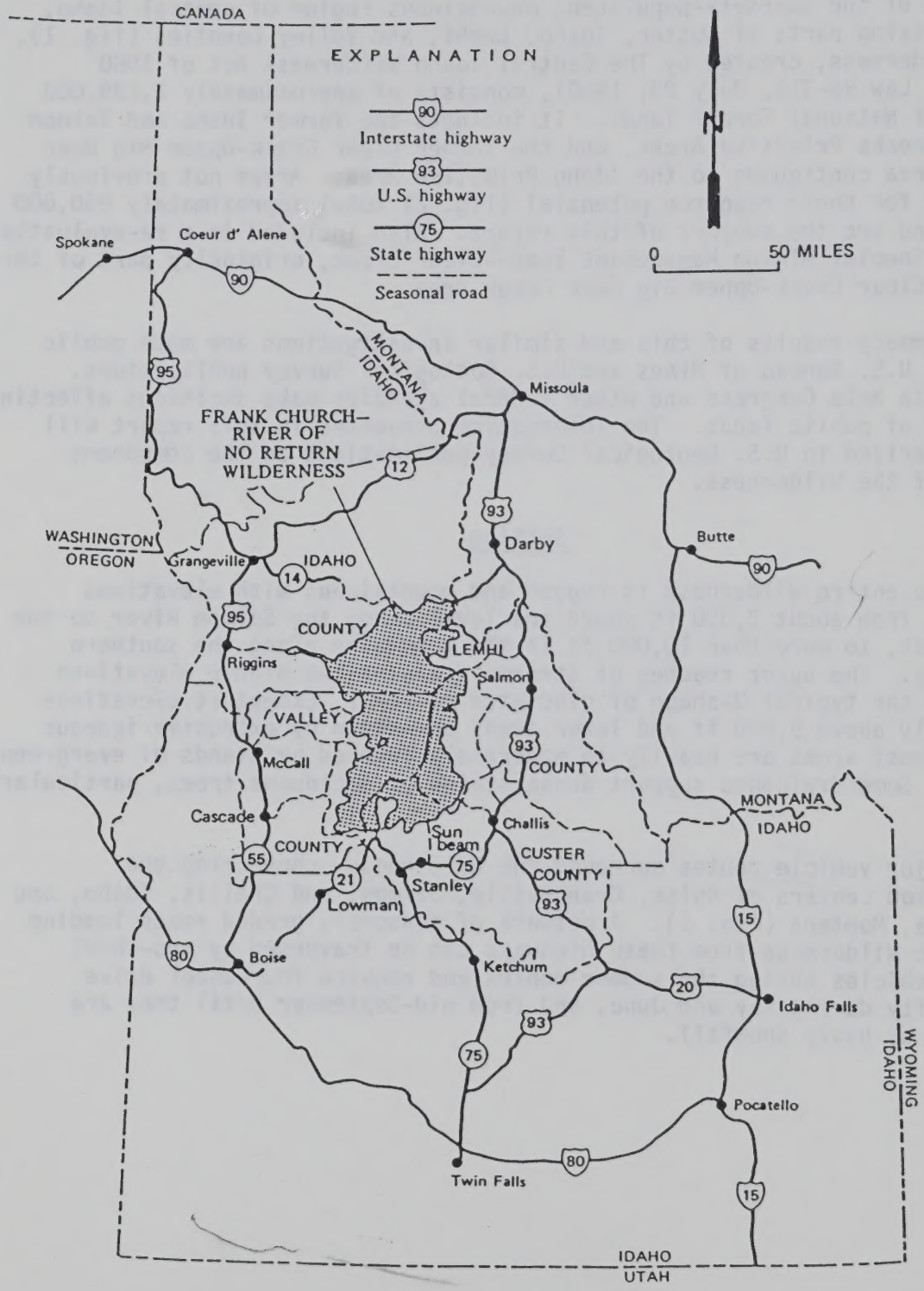


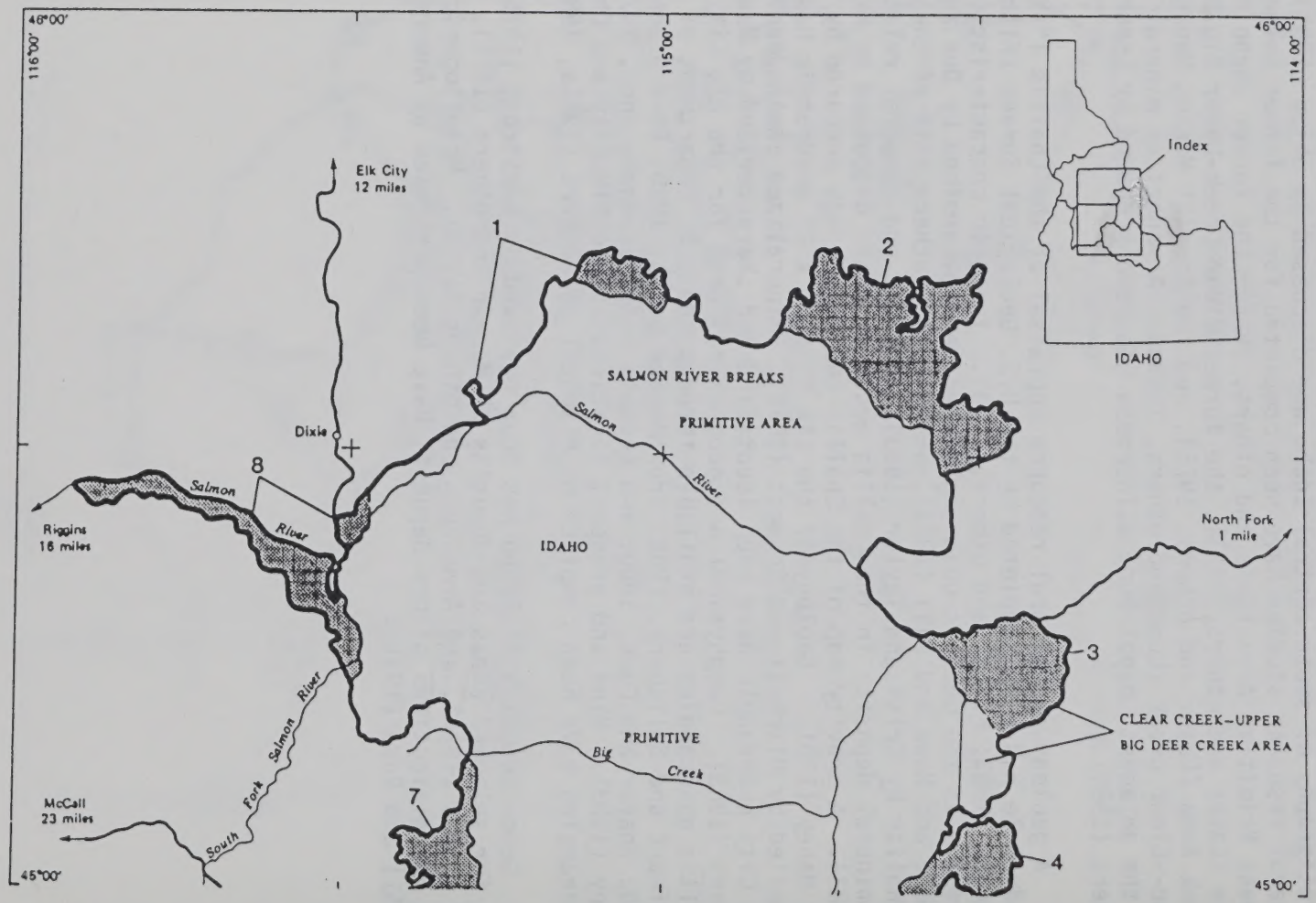
FIGURE 1.–Index map of the Frank Church-River of No Return Wilderness

Past and Present Studies

Mineral and water resources of Idaho are discussed by the U.S. Geological Survey and others (1964). Mineral potential of the Salmon River drainage basin has been addressed by Savage (1970). Structure and stratigraphy of south central Idaho are discussed by Skipp (1981). Mineral resource studies have been completed for the former Salmon River Breaks Primitive Area (Weis and others, 1972), the former Idaho Primitive Area (Cater and others, 1973), the former Clear Creek-Upper Big Deer Creek Area (Cater and others, 1975), and the Special Mining Management Zone--Clear Creek (Lund and others, 1983c). A report on mineral resources of the adjacent Gospel-Hump Wilderness has been prepared by Esparza and others (1984).

A geology and mineral resource appraisal of the Challis 1° X 2° quadrangle has been completed by the U.S. Geological Survey (Fisher and Johnson, 1983; Fisher and others, 1983). Isotopic characteristics of ore deposits in the Challis quadrangle have been determined by Doe and Delevaux (1983) and Howe and Hall (1983), and in the southern half of the Idaho batholith by Criss and Taylor (1983). Spatial and temporal relationships of mineral deposits in the Challis quadrangle are discussed by Fisher (1983). A gravity map of the Challis quadrangle was prepared by Webring and Mabey (1981). Geology of the Elk City 1° X 2° quadrangle has been compiled by Mitchell and Bennett (1979). Mineralized environments in the Elk City quadrangle have been identified and characterized by Madson and others (1983). Geophysical and geochemical data for the Elk City and Challis quadrangles are available through the U.S. Department of Energy (Leinart and Salisbury, 1982; Broxton and Beyth, 1980; EG & G geoMetrics, 1980; Thayer and Cook, 1980; and Geodata International, Inc., 1979), and Mabey (1983). Mine and prospect locations in the Elk City and Challis quadrangles have been compiled by Mitchell and others (1981a, 1981b).

Geochronometry of Idaho has been reviewed by Armstrong (1975a, 1976), and for selected areas and deposits by Marvin and others (1973), McIntyre and others (1976), and Armstrong and others (1978). Metallogenic epochs and classifications of ore deposits have been presented by Anderson (1951) and Ross (1931).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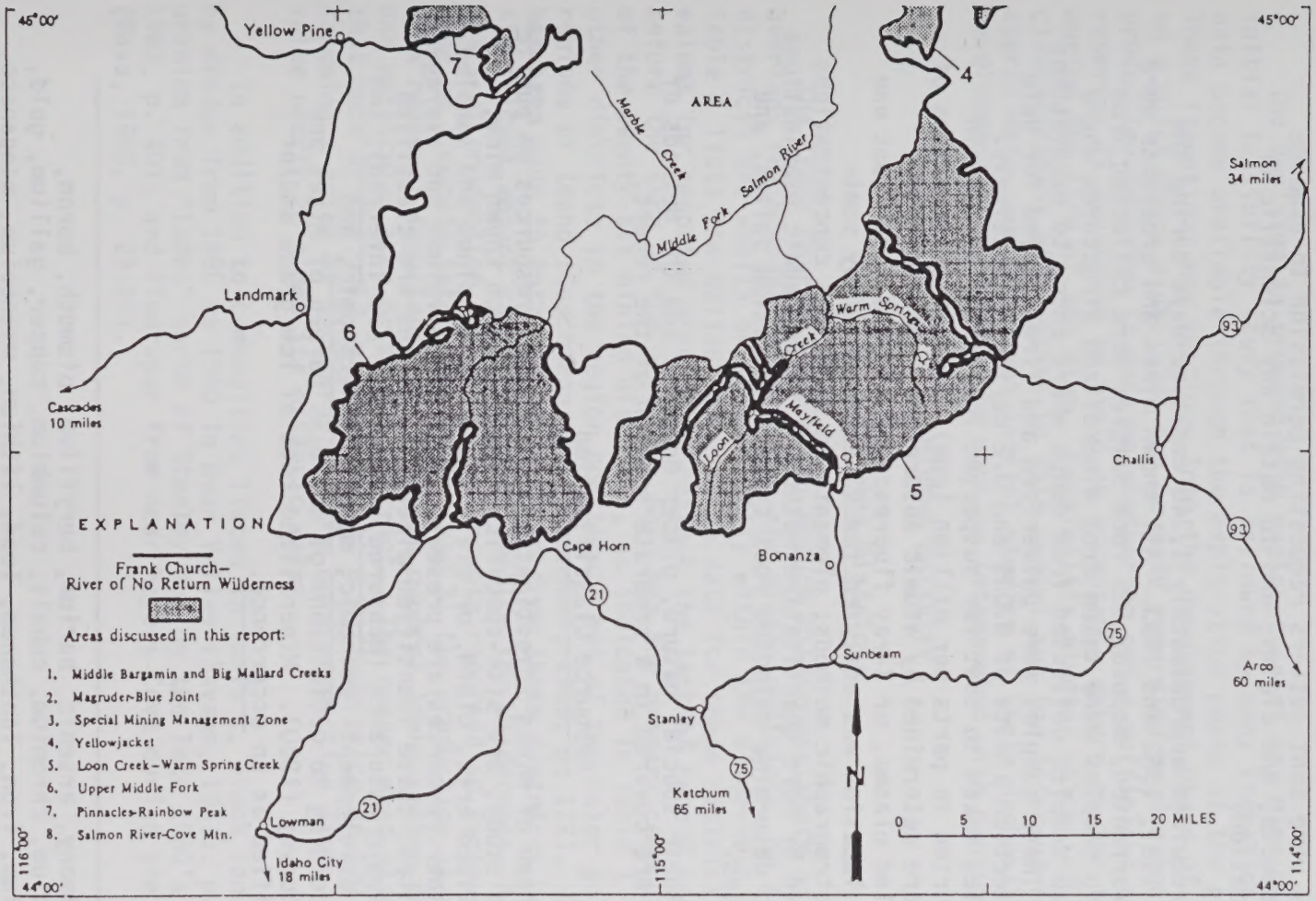

FIGURE 2.–Component units of the Frank Church-River of No Return Wilderness

Methods of Evaluation

Preliminary work included compilation of available geologic and mineral resource literature, mining claim records, and mine production data within and near the Wilderness. Claimants and owners of patented mining properties were sent letters requesting permission to examine their mines, prospects, and claims, and to obtain any scientific or historical information.

Field work required approximately 1,340 employee-days during the summer months of 1981, 1982 and 1983. All known mines and prospects were sampled, and if warranted, mapped; 925 rock samples were collected from these sites. Chip samples were taken from mineralized structures where possible, and grab samples collected from dumps where entry to excavations was prohibited. These samples were pulverized and fire-assayed for gold and silver at detection limits of 0.005 and 0.2 oz/ton respectively. Analyses of samples taken to test for suspected low levels of certain elements are reported in parts per million (ppm). Quantitative values of other elements were determined by atomic absorption, colorimetric, inductively coupled plasma, or X-ray fluorescence methods. At least one sample from each location was analyzed for 42 elements 1/ by semi-quantitative spectrographic methods; elements in anomalous concentrations were then analyzed by more quantitative methods. Petrographic examinations were performed to determine selected rock types, alteration suites, and mineral assemblages.

Because of their special nature, placer deposits and the methods of their evaluation are covered in a separate section of the report.

Resource Classification

The U.S. Bureau of Mines investigations of mineral resources on public lands, as in this study, are site-specific. That is, each known mine, prospect, mineralized area, claim, or claim group, is examined and sampled to determine whether resources are present. Tonnage or volume and average grade are calculated; these identified mineral resources are classified by levels of geologic assurance (measured, indicated, and inferred), and by potential for development (economic, marginally economic, and subeconomic), according to definitions of the U.S. Bureau of Mines and U.S. Geological Survey (1980). Mineralized rock of low grade and/or tonnage is classified as an occurrence.

1/ Aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, calcium, chromium, cobalt, columbium, copper, gallium, gold, hafnium, indium, iron, lanthanum, lead, lithium, magnesium, manganese, molybdenum, nickel, phosphorus, platinum, rhenium, scandium, silicon, silver, sodium, strontium, tantalum, tellurium, thallium, tin, titanium, vanadium, yttrium, zinc, and zirconium.

Classification of mineral resources is time-dependent and is based on the specified commodity price(s) at the time the study was conducted. Each property may have to be re-evaluated following any changes in commodity prices or component costs (equipment, labor, supplies, etc.) of a proposed mining operation.

The decision to proceed with exploration of any mine begins with an initial feasibility study that is followed by many iterations as additional data become available through the exploration phase of the project. These iterations may continue into the development phase of the project to a point where a decision can be made regarding production. The production decision is made on whether or not a sufficient quantity of reserves is available to yield an acceptable return on the investment during the life of the mine. Feasibility studies which led to classification of deposits in this report are for inferred resources, are approximate, and represent initial studies of their probability for development; the conclusions must be interpreted with caution.

MINING ACTIVITY

Mining Districts

The Frank Church-River of No Return Wilderness abuts or partially overlaps the boundaries of twenty-one mining districts; an additional five districts are wholly or substantially within the Wilderness (fig. 3). Table 1 lists the salient production data for these districts. Conflicting values for reported production reflect the lack of record keeping, mainly before the turn of the century. Gold was the primary commodity in nineteen of the twenty-six mining districts, as indicated in table 1. These and other districts in the region constitute one of two major gold-producing regions of Idaho (Koschmann and Bergendahl, 1968, p. 122). No attempt has been made to total the production from these districts because 1) a significant amount came from mines outside the Wilderness, 2) overlapping years of production and differing amounts reported in various sources make an accurate total impossible, and 3) the production is reported to show regional importance of mining in central Idaho rather than focus on one particular area or mining district. The reader must also realize that much of the gold was produced at a maximum price of $20.67/troy oz. Assuming a price of $400/troy oz, the gold production alone would have a value nearly 20 times its historic value.

In addition to commodities listed in table 1, black sands were mined by dredge from 1955 to 1960 in Bear Valley (Savage, 1961b, p. 17-18), uranium from "lodes" north of Stanley during the late 1950's (Choate, 1962, p. 40), and fluorspar from near Meyers Cove during the early 1950's (Ross, 1963, p. 23-24).

Mining History

The discovery of gold in central Idaho has been attributed to "a man named Martin" (Wells, 1961, p. 2) in 1856, and to Jean deLassier in 1857 (Lorain and Metzger, 1938, p. 6), but Captain E. D. Pierce is generally credited with its discovery and promotion in the region in 1860 (Ross, 1930b, p. 3; Staley, 1946, p. 5; Lorain and Metzger, 1938, p. 7; Wells, 1961, p. 2). The discovery of placer gold in the region soon spread to Elk City and Florence in 1861, and Warren in 1862 (Wells, 1961, p. 15). Similar discoveries in the region followed in the 1860's, but exhaustion of the richer placers led to a 10-year depression in mining from 1879 until 1889 (Ross, 1930b, p. 3). Dredging of placers began in 1897 (Ross, 1930b, p. 3) but declined to negligible production by 1917 (Lorain and Metzger, 1938, p. 8). The Depression brought a devaluation of the dollar and an increase in the price of gold from $20.67/troy oz in 1932 to $35.00/troy oz in 1935 (Anderson, 1982, p. 52). Improved access into the region, the development of new mining equipment, and the higher gold price combined to revive placer mining during the latter part of the 1930's (Lorain and Metzger, 1938, p. 8).

Lode prospecting may have begun in the Lemhi Valley in 1854 (Ross, 1930b, p. 3) but generally followed by a few years the discovery of placers (Staley, 1946, p. 6). For example, a boom in quartz mining occurred in the Warren mining district from 1866 to 1868 (Wells, 1961, p. 16) following the discovery of placers in 1862. More so than the placer mining, lode mining was sporadic usually because of a lack of access necessary for transportation of equipment, and rapid depletion of non-refractory ore amenable to amalgamation (Thomson, 1924, p. 537; Staley, 1946, p. 6). However, prior to the turn of the century, significant lode production was reported from the Yankee Fork district (Anderson, 1949, p. 13-14), Yellowjacket district (Ross, 1941a, p. 78), Warren district (Lorain, 1938, p. 76), Mineral Hill district (Umpleby, 1913c, p. 139), and the Mackinaw district (Umpleby, 1913c, p. 146).

Because of the need for raw material necessary for the United States' involvement in World War II, the Roosevelt administration issued two orders which first curtailed then ultimately closed all the Nation's mines which produced gold as the principal commodity. These were: Preference Rating Order P-56 (March 2, 1942), and Gold Mine Order L-208 (October 8, 1942) (Rott, 1943, p. 1). The first order was designed to give priority assistance in material and equipment to mines producing essential war-related commodities; the second order required the cessation of mining in all "nonessential" mines (those mines that did not produce appreciable amounts of war-related commodities). In addition to material shortages in these mines, labor shortages "...resulted from men leaving to take on Government construction projects and in war industries where abnormally high wages were paid...." (Woodward and Luff, 1943, p. 363). With the exception of the Yankee Fork district (Choate, 1962, p. 4), the Blackbird district (Bennett, 1977, p. 39-40), and the Yellow Pine district (see table 1), mining for gold as a principal commodity essentially ceased with the issuance of Order L-208.

Factors Affecting Mining

While the historic value of gold produced is relatively significant, it is by no means a measure of the potential of the region. U.S. Bureau of Mines production records show the typical boom and bust cycle for most of the mining districts, which could lead one to infer that lack of ore may have figured prominently in the decline of activity of individual mines or districts. However, Staley (1946, p. 5) lists, as factors which affected early day mining, 1) poor roads, if any; 2) hostile Indians; 3) the desire for a quick stake; 4) very inefficient metallurgical processes; and 5) unscrupulous promoters. Data available for selected mines indicates that a lack of systematic exploration based on careful mapping may also have been a contributing factor to the decline of mining. This, in turn, seems to have led to a lack of sufficient developed resources to support mills. For example, many mills were built for recovery of free-milling gold. The deeply oxidized (bonanza) portions of the veins were quickly depleted often before the original capital investment was paid back. Because primary ores could not be treated by amalgamation, operations ceased (Thomson, 1924, p. 537).

Although some of the region is still relatively inaccessible, most of the above problems have been solved. The most important factor hindering reopening of gold mines in the United States, following the rescinding of L-208 in 1945, was economics. A fixed price of gold combined with post-war inflation forced most mines which reopened during the post-war years out of business by 1963 (Anderson, 1982, p. 53). Furthermore, major advances in exploration concepts and technology were not applied to gold deposits because of the lack of a favorable investment climate (Anderson, 1982, p. 53).

The free-market value of gold, particularly since 1978, has provided the incentive to search for gold deposits through application of new geologic concepts, geologic models, and improved exploration methods (Anderson, 1982, p. 53). The major obstacle to exploration for gold and other commodities in this region, assuming favorable economic conditions, has been the large amount of land withdrawn from mineral entry, such as the former Idaho and Salmon River Breaks Primitive Areas and the Sawtooth National Recreation Area to the south.

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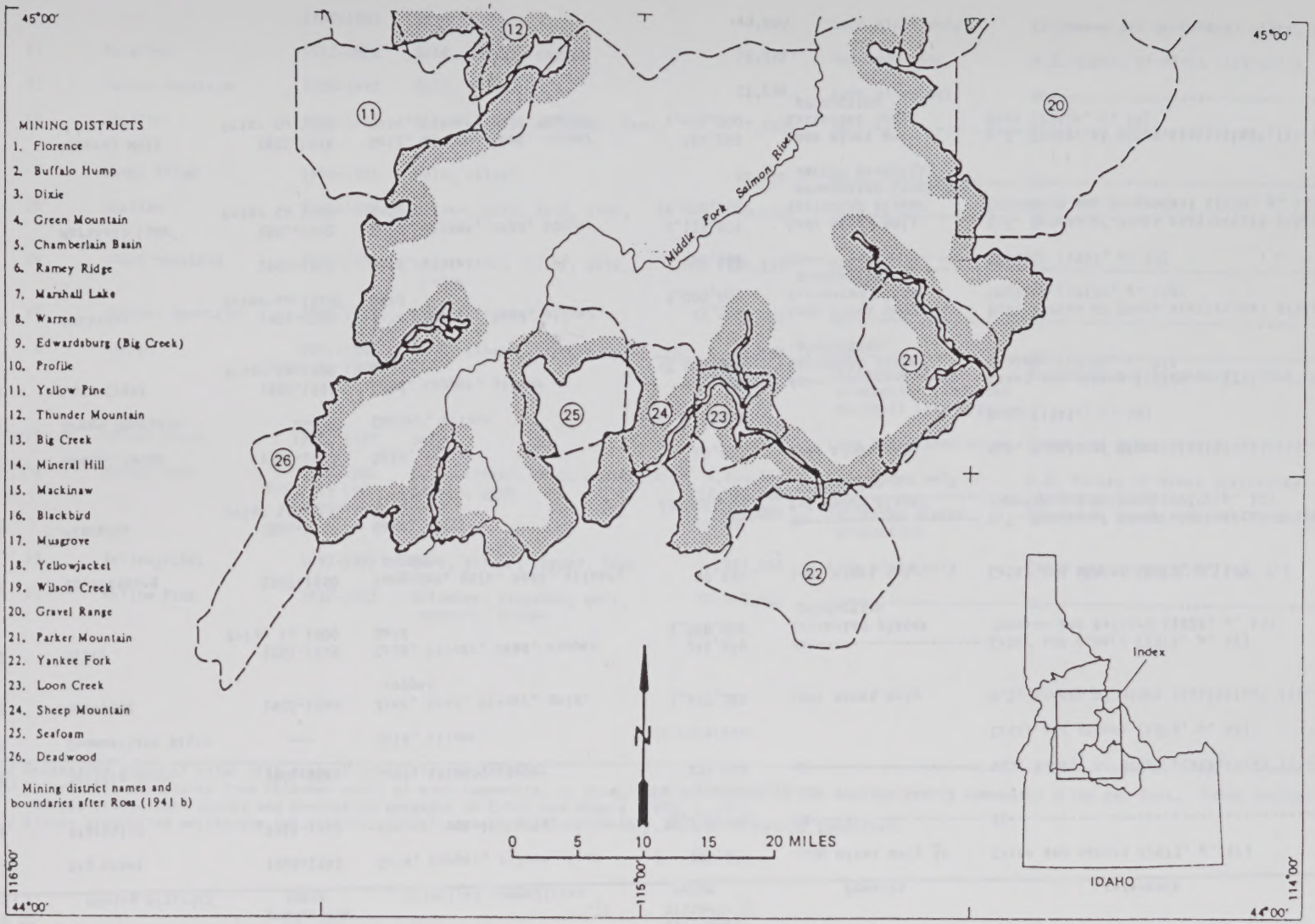

FIGURE 3.–Mining districts within and adjacent to the Frank Church-River of No Return Wilderness

Table 1.--Summary of mineral production from mining districts within or adjacent to the Frank Church-River of No Return Wilderness

Map no. (fig. 3)	Mining district	Principal productive years	Principal commodities 1/	Estimated historic 2/ value	Remarks	Reference
13	Big Creek	1935-1943	Gold, copper, silver, lead	$ 265,379	Lode mines only 3/	Cater and others (1973, p. 57)
16	Blackbird	1951-1968	Copper, cobalt, gold, silver, nickel	36,110,946	do----------	do----------
2	Buffalo Hump	1901-1941	Gold, silver, copper	777,668	do----------	U.S. Bureau of Mines statistical files
5	Chamberlain Basin	---	Gold, silver	None recorded		Cater and others (1973, p. 57)
26	Deadwood	1905-1950	Zinc, lead, silver, gold, copper	1,492,365	Lode mines only	U.S. Bureau of Mines statistical files
3	Dixie	1901-1949	Gold, silver, lead, copper	271,579	do----------	Cater and others (1973, p. 57)
		Prior to 1900	Gold	1,500,000	Estimated placer production	Thomson and Ballard (1924, p. 13)
9	Edwardsburg	1907-1950	Tungsten, gold, lead, silver, copper	97,485	Lode mines only	Cater and others (1973, p. 57)
1	Florence	1901-1940	Gold, silver	20,000	do----------	U.S. Bureau of Mines statistical files
		Prior to 1900	Gold	22,500,000	Estimated placer production	Thomson and Ballard (1924, p. 13)
20	Gravel Range	1907-1938	Gold, silver	10,232	Lode mines only	U.S. Bureau of Mines statistical files
4	Green Mountain	---	Copper, silver	None recorded		Ross (1941a, p. 56)
23	Loon Creek	1903-1941	Gold, copper, silver	710,424	do----------	Cater and others (1973, p. 57)
		Prior to 1900	Gold	≤2,000,000	Estimated placer production.	Umpleby (1913b, p. 91)
15	Mackinaw	1901-1953	Gold, copper, lead, silver	71,128	Lode mines only	U.S. Bureau of Mines statistical files
		Prior to 1910?	Gold	5,000,000	Estimated placer production	Umpleby (1913c, p. 146)
		1901-1954	Gold, silver	206,555	do----------	Shockey (1957, p. 33)
7	Marshall Lake	1901-1942	Gold, silver, lead, copper	2,137,078	Lode mines only	U.S. Bureau of Mines statistical files
		Prior to 1900	Gold	15,000,000	Estimated placer production (includes Warren district)	Koschmann and Bergendahl (1968, p. 133)
14	Mineral Hill	1901-1948	Gold, silver, lead, copper	769,269	Lode mines only	U.S. Bureau of Mines statistical files
		Prior to 1910	Gold, silver, lead, copper	1,400,000	Estimated lode production	Ross (1941a, p. 74)

		1932-1959	Gold	768,000	Lode mines only	Koschmann and Bergendahl (1968, p. 136)
17	Musgrove	1913-1921	Gold, silver, copper	35,372	One lode mine	U.S. Bureau of Mines statistical files
21	Parker Mountain	1905-1942	Gold, silver	21,594	Lode mines only	do
10	Profile	1914-1946	Silver, gold, antimony, lead, copper	7,993	do	Cater and others (1973, p. 57)
6	Ramey Ridge	1932-1941	Gold, silver	47,126	do	do
25	Seafoam	1910-1958	Silver, gold, lead, zinc, copper	49,194	do	do
24	Sheep Mountain	1945-1954	Lead, zinc, silver, gold, copper	324,117	do	do
12	Thunder Mountain	1902-1942	Gold, silver	526,603	do	do
8	Warren	1901-1942	Gold, silver, lead, copper, zinc	3,462,137	do	do
		Prior to 1900		15,000,000	Estimated placer production (includes Marshall Lake district)	Koschmann and Bergendahl (1968, p. 133)
19	Wilson Creek	1902, 1912	Gold	186	Lode and placer mines	Cater and others (1973, p. 57)
22	Yankee Fork	1902-1955	Gold, silver, lead, copper, zinc	1,338,734	Lode mines only	U.S. Bureau of Mines statistical files
		Prior to 1900	Silver, gold	12,000,000	do	Anderson (1949, p. 3)
		1948-1959	Gold	500,000	Estimated placer production	Koschmann and Bergendahl (1968, p. 128)
18	Yellowjacket	1893-1965	Gold, silver, copper, lead	247,964	Lode mines only	Cater and others (1973, p. 57)
11	Yellow Pine	1932-1952	Antimony, tungsten, gold, mercury, silver	52,645,682	do	do

1/ Decreasing order of value with respect to total production.
2/ Values were calculated from recorded units of each commodity, by year, then multiplied by the average yearly commodity price per unit. These include Bureau production records and production recorded in Cater and others (1973, p. 57).
3/ Placer production negligible for districts with lode mine production only, unless otherwise specified.

Present Activity

Despite restrictions imposed on mining operations in or near designated wilderness areas, Phillips Petroleum Co. and Denison Mines, Inc., were actively exploring known gold deposits in the Thunder Mountain and Parker Mountain mining districts, respectively, in 1982, and Cabot Mining Resources was drilling the Springfield tungsten property. Houston International Minerals Corp., in joint venture with Denison Mines, Inc., core drilled the Parker Mountain property in 1983, and Coeur d'Alene Mines, Inc. and Thunder Mountain Gold continued exploration, begun by Phillips Petroleum Co., in the Thunder Mountain-Lightning Peak area. Just outside the study area's southern boundary, Anaconda Minerals drilled a ferro-alloy target in Pioneer Creek drainage in 1981, and Noranda drilled a precious metal target on Red Mountain. Superior Mining Co., initiated production at the West End deposit in 1982, just a few miles west of the Wilderness in the Yellow Pine mining district. Of major interest has been the continued development of the Thompson Creek molybdenum deposit, a few miles southeast of the southern part of the Wilderness.

GEOLOGIC SUMMARY

General Statement

The dominant features of the Wilderness are the Cretaceous Idaho batholith and spatially associated Tertiary plutons (fig. 4). The batholith intruded older metasedimentary and sedimentary rocks and the entire area was uplifted and eroded prior to emplacement of Tertiary plutons and eruption of comagmatic volcanic flows and ejecta. Subsequent uplift and erosion has left the core of the batholith rimmed by older and younger rocks so that a cross section midway through the Wilderness along the 45th Parallel would show a broad, dome shape. Rocks surrounding the core of the batholith host most of the known mineral deposits and occurrences, and thus are most likely to have resources (Thomson, 1924, p. 533-535; Ross, 1927, p. 1). The areas discussed in this report coincide, for the most part, with mineralized zones peripheral to the batholith.

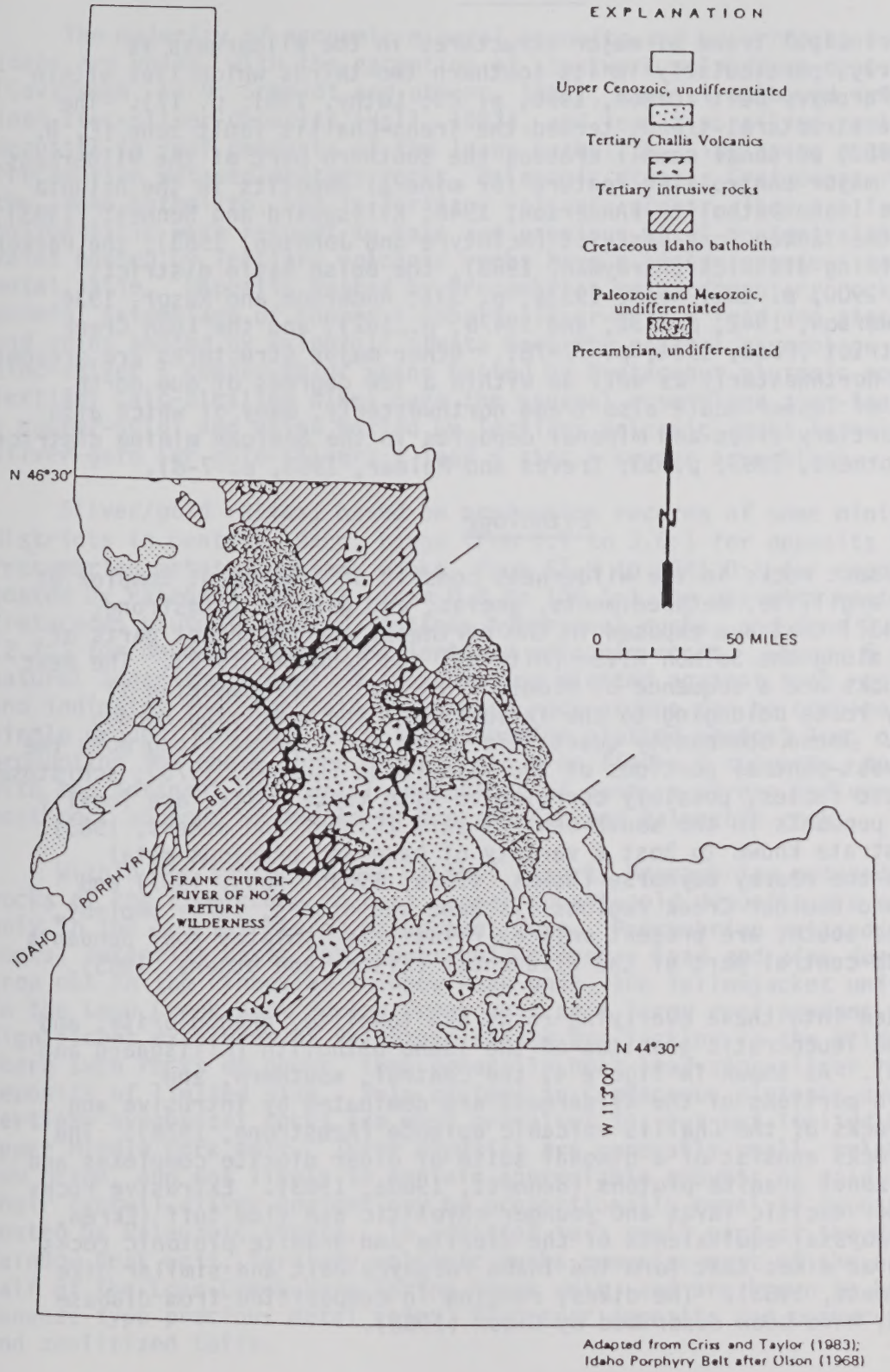

FIGURE 4.–General geology of central Idaho (between lat. 44°30' and 46°30'N., and west of long. 113°00'W.)

Structure

The principal trend of major structures in the Wilderness is northeasterly, particularly in its southern two-thirds which lies within the Idaho Porphyry Belt (Olson, 1968, p. 23; Luthy, 1981, p. 17). The axis of the structural trend, termed the Trans-Challis fault zone (E. H. Bennett, 1983, personal comm.) crosses the southern part of the Wilderness and is the major controlling feature for mineral deposits in the Atlanta lobe of the Idaho batholith (Anderson, 1948; Killsgaard and Bennett, 1983), including the Yankee Fork district (McIntyre and Johnson, 1983), the Parker Mountain mining district (Hardyman, 1983), the Boise Basin districts (Lindgren, 1900, p. 102; Ross, 1933a, p. 331; Anderson and Rasor, 1934, p. 387; Anderson, 1942, p. 132, and 1947b, p. 162), and the Loon Creek mining district (Ross, 1934, p. 77-78). Other major structures are present that trend northwesterly as well as within a few degrees of due north. Structures of lesser scale also trend northwesterly, many of which also localize Tertiary dikes and mineral deposits in the Seafoam mining district (Lowe and others, 1983, p. 13; Treves and Melear, 1953, p. 7-8).

Lithology

The oldest rocks in the Wilderness consist of a basement complex of quartzite, argillite, metasediments, gneiss, and granite (Armstrong, 1975b, p. 437) that are exposed in the northwest and northeast parts of the region along the Salmon River (Mitchell and Bennett, 1979). The next youngest rocks are a sequence of Middle Proterozoic (Precambrian Y) sedimentary rocks belonging to the Yellowjacket and overlying Hoodoo Formations. These dominantly quartzitic units are exposed along both the east- and west-central portions of the Wilderness (Ruppel, 1975); schistose to quartzitic facies, possibly correlative with these units, are locally exposed as pendants in the south-central part (Fisher and others, 1983). Paleozoic strata known to host a variety of base-and precious-metal deposits in the nearby Bayhorse (Hobbs, 1983a, 1983b; Ross, 1937) and East Fork and Boulder Creek regions (Tschanz and others, 1974; Umpleby, 1915) to the south, are present only as relatively isolated roof pendants in the south-central part of the Wilderness (Fisher and others, 1983).

Intruded into these overlying rocks are tonalite, granodiorite, and two-mica and leucocratic granites of the Idaho batholith (Kiilsgaard and Lewis, 1983). As shown in figure 4, the central, southern, and southeastern portions of the Wilderness are dominated by intrusive and extrusive rocks of the Challis volcanic episode (Armstrong, 1978). The intrusive rocks consist of a bimodal suite of older diorite complexes and younger epizonal granite plutons (Bennett, 1980a, 1983). Extrusive rocks include older dacitic lavas and younger rhyolitic ash flow tuff (Ekren, 1983). Hypabyssal equivalents of the diorite and granite plutonic rocks are present as dikes that form the Idaho Porphyry Belt and similar dike swarms (Bennett, 1983). The dikes, ranging in composition from diabase to rhyolite, have been described by Olson (1968).

MINERAL DEPOSITS

The majority of economic mineral deposits and occurrences in central Idaho are veins, with the exception of stockwork molybdenum deposits (Cavanaugh, 1979; Schmidt and others, 1982), some stratabound syngenetic lead-zinc-silver deposits (Hall, 1983), and lead-zinc-silver replacement deposits in roof pendants of the Idaho batholith. The veins occur in Precambrian metasedimentary rocks, Paleozoic strata, Cretaceous rocks of the Idaho batholith, and in Tertiary volcanic rocks. They are largely polymetallic with respect to base and precious metal content although veins hosted by Tertiary volcanic rocks have a higher precious-to-base metal ratio. Deposits hosted by Precambrian metasedimentary rocks have the general assemblage of copper $\pm$ cobalt-silver-gold $\pm$ lead and zinc; skarns and veins hosted by Paleozoic strata have the general assemblage of lead-zinc-silver $\pm$ copper-gold; veins hosted by Cretaceous plutonic rocks + Tertiary calc-alkaline dikes have the general assemblage zinc-lead-silver $\pm$ copper-gold; and veins hosted by Tertiary volcanic rocks largely have a silver-gold (or gold-silver) $\pm$ lead $\pm$ zinc $\pm$ copper assemblage.

Silver/gold ratios, based on production records of some mining districts in central Idaho, range from 0.7 to 3.6:1 for deposits hosted by Precambrian metasedimentary rocks, from 57.9 to 4241.0:1 for deposits hosted by Paleozoic strata, from 0.2 to 109.5:1 for deposits hosted by Cretaceous plutonic and/or Tertiary hypabyssal rocks, and from 0.6 to 12.7:1 for deposits hosted by Tertiary volcanic rocks. Figure 5 shows the natural logarithm ($\log_e$) of these ratios plotted against host rock groupings and indicates that the latter two host rock groups can be combined into a single group. The $\log_e$ of gold production plotted against $\log_e$ of silver production for these three groups, shown on figure 5 suggests, together with the dominant base metal assemblage of each, a strong influence of host rock sources of metals in Precambrian and Paleozoic rocks.

Within the subject areas of this report, Precambrian metasedimentary rocks of the type known to host copper-cobalt-gold deposits are exposed only in the Special Mining Management Zone. Precambrian metasedimentary rocks, potential hosts for copper-gold-silver + lead and zinc deposits crop out in the Pinnacles-Rainbow Peak unit, the Yellowjacket unit, and in the Loon Creek-Warm Spring Creek unit as a large roof pendant. Significant exposures of Paleozoic strata are lacking in the Wilderness. Where such rocks do occur, they generally host lead-zinc-silver replacement deposits of limited size. Vein systems in Cretaceous plutonic and/or Tertiary hypabyssal rocks are most prevalent in, but not limited to, the Upper Middle Fork unit. These deposits are generally small, relatively low grade, and not likely to contain appreciable amounts of gold; however, their overall silver content may be proportionally equal to deposits hosted by Paleozoic strata. In addition to a small part of the Pinnacles-Rainbow Peak unit, Tertiary volcanic rocks comprise most of the eastern half of the Loon Creek-Warm Spring Creek unit, and are known to host bonanza-type precious metal veins, fluorspar deposits and occurrences, and zeolitized tuffs.

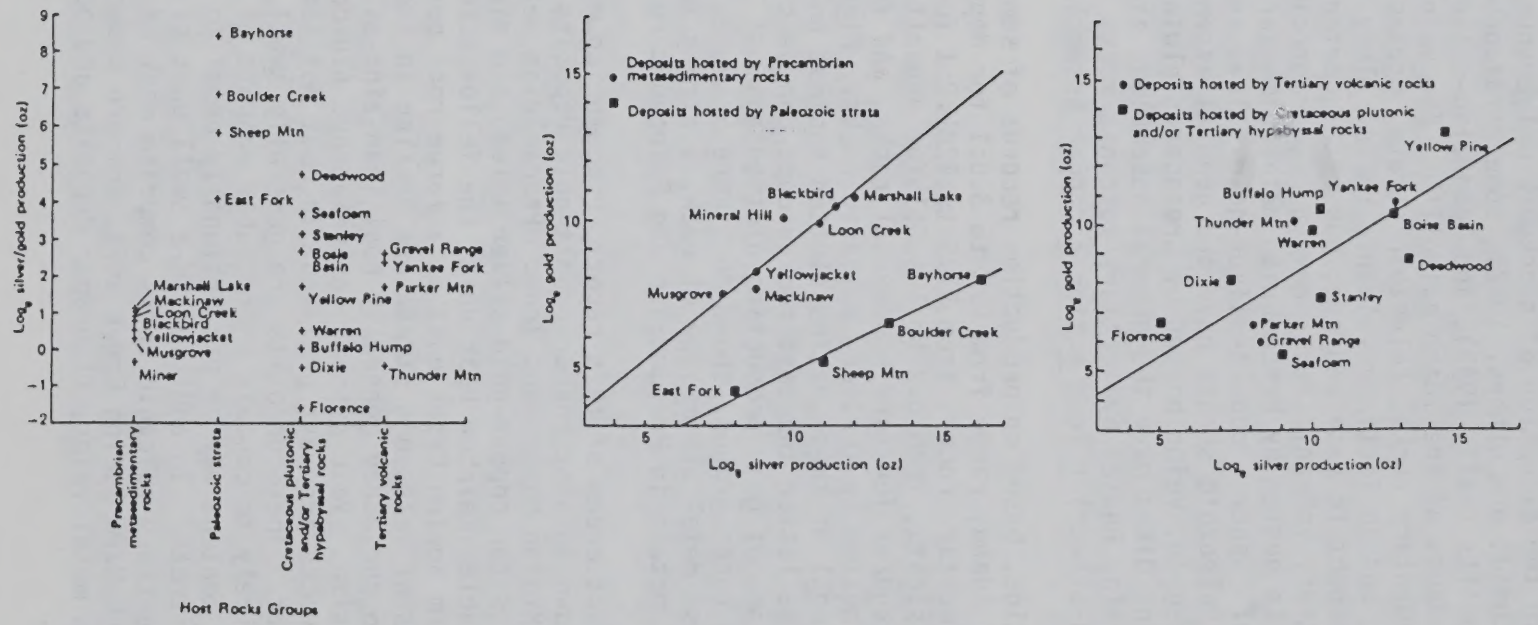

FIGURE 5.—Silver/gold ratios of selected mining districts in central Idaho

The end uses, apparent consumption, net import reliance, recent price per unit and other salient data regarding commodities present in the Wilderness are given in the the Appendix.

MINERAL APPRAISAL OF THE LOON CREEK-WARM SPRING CREEK UNIT, CUSTER AND LEMHI COUNTIES, IDAHO

by

Andrew M. Leszcykowski, James Ridenour,
Spencee L. Willett, Michael S. Miller
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INTRODUCTION

Location and Access

The Loon Creek-Warm Spring Creek unit (fig. 6) encompasses about 294,000 acres in the southeastern part of the Frank Church-River of No Return Wilderness and includes parts of Custer and Lemhi Counties. The northwestern boundary of the unit abuts the former Idaho Primitive Area, and the southeastern boundary generally follows the drainage divide between the north-northwesterly flowing tributaries of the Middle Fork Salmon River and the south-southeasterly flowing tributaries of the Salmon River. The northeastern boundary is formed by Camas Creek. Graded roads leading from State Highways 21 and 75 and U.S. Highway 93 (fig. 1) provide access to the study area (fig. 6).

Setting

The unit is mountainous with steep-sided narrow valleys and high, narrow ridges. Elevations range from 10,329 ft, at the crest of The General in the southwestern part of the area, to about 4,830 ft on Loon Creek near Falconberry Guard Station. Sleeping Deer Mountain (9,885 ft), Twin Peaks (10,340 ft), Sherman Peak (9,892 ft), Mount Jordan (10,963 ft), and Pinyon Peak (9,942 ft) are among many peaks in excess of 9,000 ft elevation.

Dense stands of Douglas fir, lodgepole pine, and ponderosa pine are common in stream valleys; Engelmann spruce grows on ridge crests and mountain tops. Sagebrush and a variety of shrubs are common on flats and benches along the streams and on the lower slopes of the stream valleys.

Precipitation occurs primarily as snow from November to April; thunder storms are frequent during summer months. Snow accumulation blocks access roads into the area during the winter, but seldom hinders activity in the stream valleys. Roads over the passes are usually snowbound from October to May. Spring runoff in streams frequently washes out parts of the Loon Creek-Beaver Creek road, particularly along Canyon Creek in the vicinity of the Lost Packer Mine.

Previous Investigations

Geology and mineral deposits of portions of the unit are discussed by Umpleby (1913a, 1913b, 1913c), Umpleby and Livingston (1920), Ross (1927, 1934), U.S. Bureau of Mines (1943, 1945), Anderson (1954a, 1954b), and Cox (1954). Fisher and others (1983) and Fisher and Johnson (1983) present the results of recent geologic and mineral deposit studies in the Challis 1° by 2° quadrangle. Geologic theses of various areas within the unit have been written by Dobey (1972), Sibbett (1976), Stiles (1976), Yinger (1976), Fenne (1977), Rahn (1979), and Wagstaff (1979). Geochemical surveys in the unit have been conducted by Knowles and Bennett (1978) and Knowles (1979). Mines and prospects are listed by Mitchell and others (1981a), Leszcykowski and others (1983), and Ridenour and others (1983).

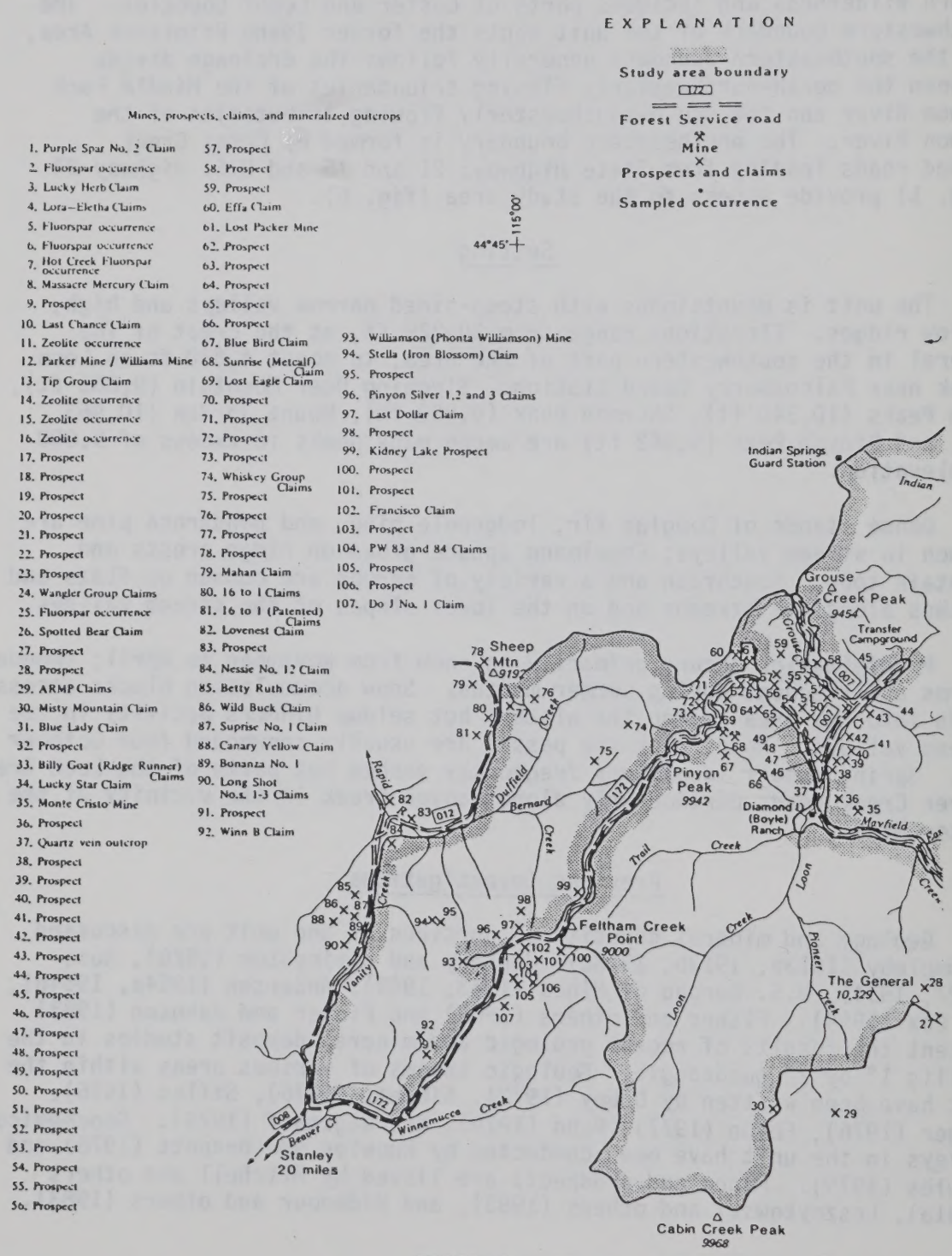
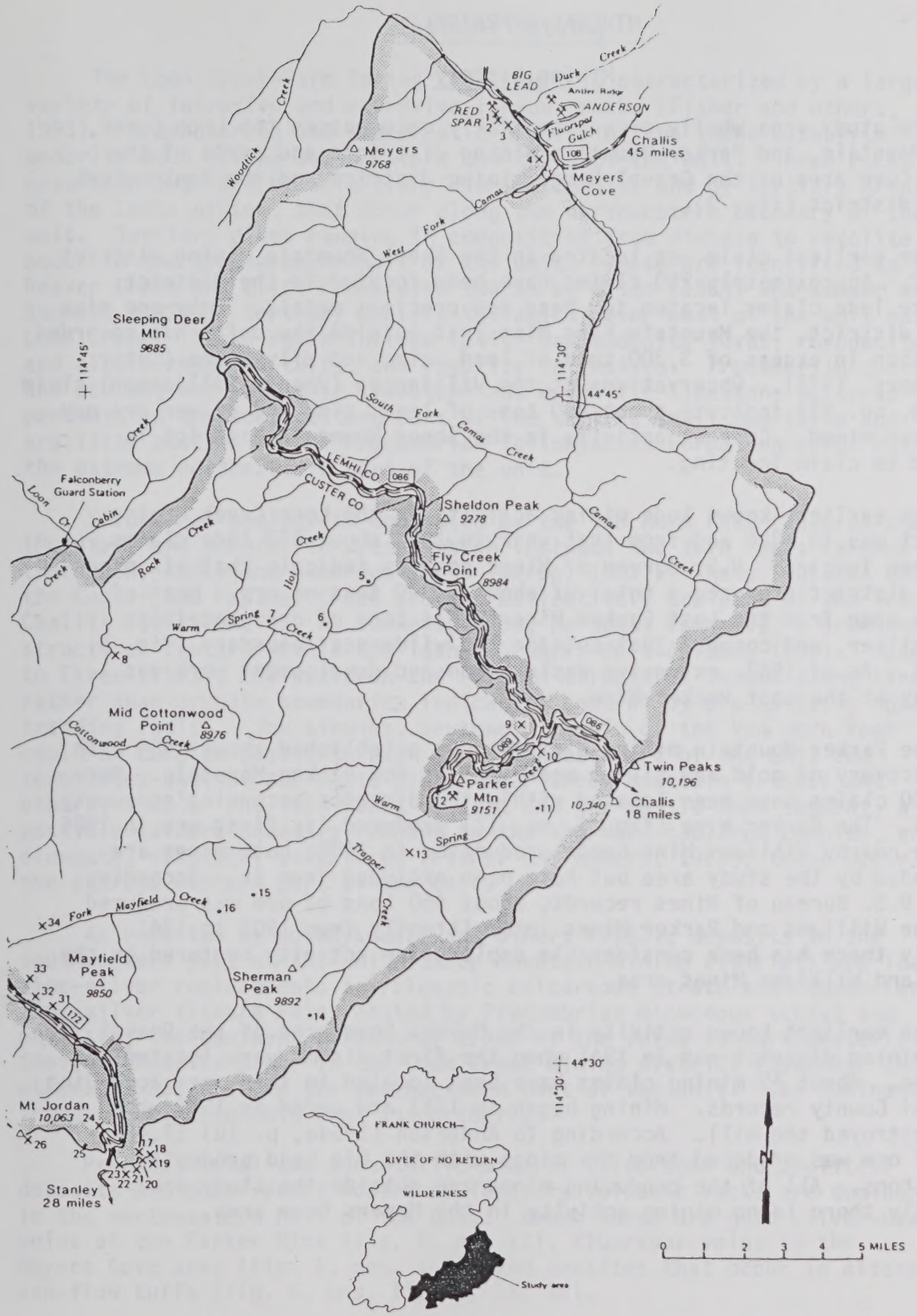


FIGURE 6.–The Loon Creek-Warm Spring Creek



unit, Custer and Lemhi Counties, Idaho

MINERAL APPRAISAL

Mining History

The study area wholly or substantially encompasses the Loon Creek, Sheep Mountain, and Parker Mountain mining districts and parts of the Meyers Cove area of the Gravel Range mining district and the Yankee Fork mining district (fig. 3).

The earliest claim was located in the Sheep Mountain mining district in 1882. Approximately 250 claims have been located in the district; most are lode claims located for base and precious metals. Only one mine in the district, the Mountain King Mine just outside the unit, has recorded production in excess of 3,300 tons of lead, zinc and silver ore (Cater and others, 1973). Observations at the Williamson (Phonta-Williamson) claim (fig. 6, no. 93) indicate about 400 tons of lead, zinc and silver ore may have been mined. Current activity in the Sheep Mountain district is limited to claim locating.

The earliest known lode mining activity in the Loon Creek mining district was in 1886 and from that year to 1983 about 650 lode claims have been located. U.S. Bureau of Mines records indicate that six mines in the district produced a total of about 9,900 tons of ore. Most of the ore came from the Lost Packer Mine (9,874 tons of ore containing gold, silver, and copper) just outside the wilderness boundary (fig. 6, no. 61). As of 1983, extensive exploration and development work was underway at the Lost Packer Mine.

The Parker Mountain mining district was established about 1904 with the discovery of gold and silver near what is now Parker Mountain. More than 120 claims have been located within the district according to county records. The Parker Mine (fig. 6, no. 12) produced its first ore in 1905 and the nearby Williams Mine began production in 1908; both mines are surrounded by the study area but have been excluded from it. According to the U.S. Bureau of Mines records, about 450 tons of ore was produced from the Williams and Parker Mines intermittently from 1905 to 1941. Recently there has been considerable exploration activity centered on the Parker and Williams Mines area.

The earliest known activity in the Meyers Cove area of the Gravel Range mining district was in 1941 when the first claims were located for fluorite. About 75 mining claims have been located in this area according to Lemhi County records. Mining began in 1951 and ended in 1953 when fire destroyed the mill. According to Anderson (1954a, p. 10) 37,432 tons of ore was produced from six mines with the Big Lead producing 29,304 tons. All of the producing mines are outside the study area. Currently there is no mining activity in the Meyers Cove area.

Geologic Setting

The Loon Creek-Warm Spring Creek unit is characterized by a large variety of intrusive and extrusive igneous rocks (Fisher and others, 1983). Granodiorite and leucocratic granite of the Idaho batholith underlie much of the southwestern one-third of the unit. These rocks have been intruded by a Tertiary diorite complex and by Tertiary granites of the Casto pluton, that occur along the northwestern boundary of the unit. Tertiary dikes ranging in composition from diabase to rhyolite occur in the southwestern part of the unit. These are identified as the Beaver Creek and Cliff Creek dike swarms by Olson (1968) and Rember and Bennett (1979). Tertiary Challis Volcanics cover most of the unit east of Loon Creek. These rocks include latite and andesite lavas, rhyodacite and alkali-rhyolite tuffs, and rhyolite intrusives. Precambrian quartzite and schist, and Paleozoic limestone and dolomitic limestone occur as pendants in the southwestern part of the unit; a small quartzite and argillite section of the Precambrian Yellowjacket Formation crops out in the extreme northeastern part of the unit.

Structural geology is dominated by the Van Horn Peak cauldron complex (McIntyre and others, in press) which includes the Twin Peaks caldera (Hardyman, 1981) and numerous vents (Ekren, 1981). These features and the Custer and Panther Creek grabens collectively are part of the Trans-Challis fault zone (E. H. Bennett, 1983, personal commun.), a prominent structural feature within the Idaho Porphyry Belt (Olson, 1968). According to Ekren (1983), the cauldron and related structures formed along linear rather than arcuate boundaries indicating control by pre-existing northeast-trending faults. The sinuous, southwest margin of the Van Horn Peak cauldron complex passes through the southwest part of the unit and terminates against the Casto pluton near Sheep Mountain (Fisher and others, 1983). The Twin Peaks caldera and the Castle Rock segment, a possible caldera boundary remnant in the Van Horn cauldron complex, are elongate, eliptical structures (Fisher and others, 1983); these occur in the extreme eastern part of the unit.

As reported by Leszcykowski and others (1983), deposits in the southwestern part of the unit (Sheep Mountain mining district) are lead-zinc-silver replacements in Paleozoic calcareous strata and copper-lead-zinc-silver fissure veins hosted by Precambrian micaceous schist and phyllite; the dominant structural trend of the veins is northwesterly. Similar deposits occur in the Loon Creek mining district (Ridenour and others, 1983) also in the southwestern part of the unit. The dominant trend of veins in this area is northerly.

Precious-metal and nonmetallic-mineral (fluorspar and zeolites) deposits and occurrences hosted by Tertiary volcanic rocks are dominant in the northeastern half of the unit. Among these are gold-silver-bearing veins at the Parker Mine (fig. 6, no. 12), fluorspar veins in the Meyers Cove area (fig. 6, nos. 1-4), and zeolites that occur in altered ash-flow tuffs (fig. 6, nos. 11, 14, 15, 16).

Collectively, deposits and occurrences in the unit tend to cluster along known or inferred major volcano-tectonic features. For example, the Parker and Williams Mines (fig. 6, no. 12) are on the west margin of the Twin Peaks caldera (Hardyman, 1983); the Meyers Cove fluorspar veins and deposits in the Loon Creek mining district are related to internal and marginal structures of the Van Horn Peak cauldron complex (Fisher and others, 1983). Zeolitized tuffs occur along a northeast-trending medial fracture through the Twin Peaks caldera (Hardyman, 1983). Deposits in the southwestern part of the unit lie adjacent to an inferred major northeast-trending fault that may be part of the Trans-Challis fault zone (E. H. Bennett, 1983, personal communication).

Mines, Prospects, Claims, and Mineralized Areas

A total of 472 samples were collected from 112 mines, prospects, claims, and mineralized outcrops within or adjacent to the unit. Important mines, prospects, and mineralized outcrops are discussed below. Those which have no apparent resources or are not sufficiently exposed to permit evaluation, are listed in table 2.

Lost Packer Mine

The Lost Packer Mine (fig. 6, no. 61) is on the north side of Canyon Creek and is accessible by Forest Service Road 172. Elevation of the lowermost adit (no. 10 level) is 7,210 ft.

The mine, located originally by Clarence E. Eddy in 1902, was named for a packer who discovered an outcrop of the vein system in about 1866 (Ross, 1934, p. 117). Eddy and his partner began exploration mining from an open cut. They soon sold their interests to the Lost Packer Mining Co. which patented four claims in 1903. The Lost Packer Mining Co. sold their interests to James Ivers and a partner in 1904 (Shockey, 1963, p. 3). Intensive development began in 1904, and a 100 ton-per-day smelter was completed in 1905 (Umpleby, 1913b, p. 91). An unspecified accident with the furnace during its first shift of operation (Bell, 1906, p. 48) resulted in operations being delayed until 1907, when the smelter was run for 34 days (Bell, 1907, p. 72). The furnace was reported to have run in 1908 (Bell, 1908, p. 9), in 1911 (Bell, 1911, p. 40), in 1913 (Bell, 1913, p. 151), and in 1914 (Ross, 1934, p. 118). Metallurgical difficulties with the ore and the cost of transporting coke from Mackey, 110 miles distant, were probably the main reasons for intermittent operation of the smelter (Ross, 1934, p. 118). The smelter and mine were essentially shut down in 1917 because of failure to find additional ore and lack of success of a new mill installed in 1916 (Shockey, 1963, p. 5).

Bureau of Mines records show a small amount of ore produced in 1925 and again in 1937. This was produced by James Ivers II who reopened adits which partially caved following the 1917 shutdown (Shockey, 1963, p. 6) The entire surface plant and most of the timbers at the portals of the adits were destroyed by a forest fire in 1931 (Campbell, 1931, p. 127) rendering the underground workings inaccessible. The mine lay dormant until 1960, when James Ivers III, the third generation owner-operator, renewed efforts to find extensions of the ore zone on the No. 7 and No. 10 levels. Most of the seasonal work has concentrated on cleaning out these two levels, timbering unsafe areas of the drifts and crosscuts, and driving new access around caved sections. In 1979, Ivers initiated a core drilling program on the No. 7 level; it resulted in discovery of a new vein, tentatively called the "Rediscovery Vein". This vein was crosscut in 1983. Rehabilitation and exploration of the Lost Packer Mine has been totally financed by James Ivers III.

Recorded production from the mine is 9,874 tons of ore with an average grade of 2.0 oz gold/ton, 4.9 oz silver/ton, and 182 lb copper/ton. Much of this ore, hand sorted for transportation to the smelter, was taken from the higher-grade shoots of the vein system; the ore averaged $72/ton at prevailing prices (gold was mostly $20.67 or less/oz) according to Shockey (1963, p. 8). According to Umpleby (1913b, p. 97), high grade ore ran between $80 and $90/ton and lower grade material, estimated to be 2.5 times more plentiful than higher grade ore, averaged $25/ton.

Historic development includes approximately 12,750 ft of lateral underground workings on 10 levels open or formerly open to the surface and 5 additional blind sublevels (Shockey, 1963, p. 5) accessible only from raises now blocked or unsafe to enter. Smaller, unnumbered adits on the Effa (fig. 6, no. 60) and Utah claims, and in the vicinity of the No. 4 level (fig. 7), do not expose the vein.

The vein, explored over a vertical distance of about 1,000 ft and a horizontal distance of about 2,000 ft, is enclosed in a fissure that strikes N. 5° E., and dips 75° NW. (Umpleby, 1913b, p. 94) and is hosted by a Precambrian quartz-biotite schist (Ross, 1934, p. 23) broadly gradational with quartzite and micaceous quartzite (Shockey, 1963, p. 11). The vein ranges from less than an inch to as much as 5 ft wide but averages about 20 in. (Umpleby, 1913a, p. 71). Both walls of the vein are well-defined and often marked by gouge. The fissure cuts granite as well as schist (Umpleby, 1913b, p. 96) and post-dates dikes identified as lamprophyre (Umpleby, 1913b; Ross, 1934). The quartz vein is cut by dacite porphyry and granophyre dikes (Shockey, 1963, p. 15; Ross, 1934, p. 121), also identified as diorite porphyry and granite porphyry by Umpleby (1913a, p. 71; 1913b, p. 96). Post-mineral faulting caused minor offsets of the vein (Ross, 1934, p. 121).

The ore was essentially composed of auriferous chalcopyrite with some inclusions of pyrite and pyrrhotite (Umpleby, 1913a, p. 72). The gangue was mainly quartz, siderite, and host rock fragments (Ross, 1934, p. 122) in varying proportions in the three ore shoots (Umpleby, 1913b, p. 96). Umpleby (1913a, p. 72) reported most of the gold was in the quartz and chalcopyrite, with only a small amount present in the siderite.

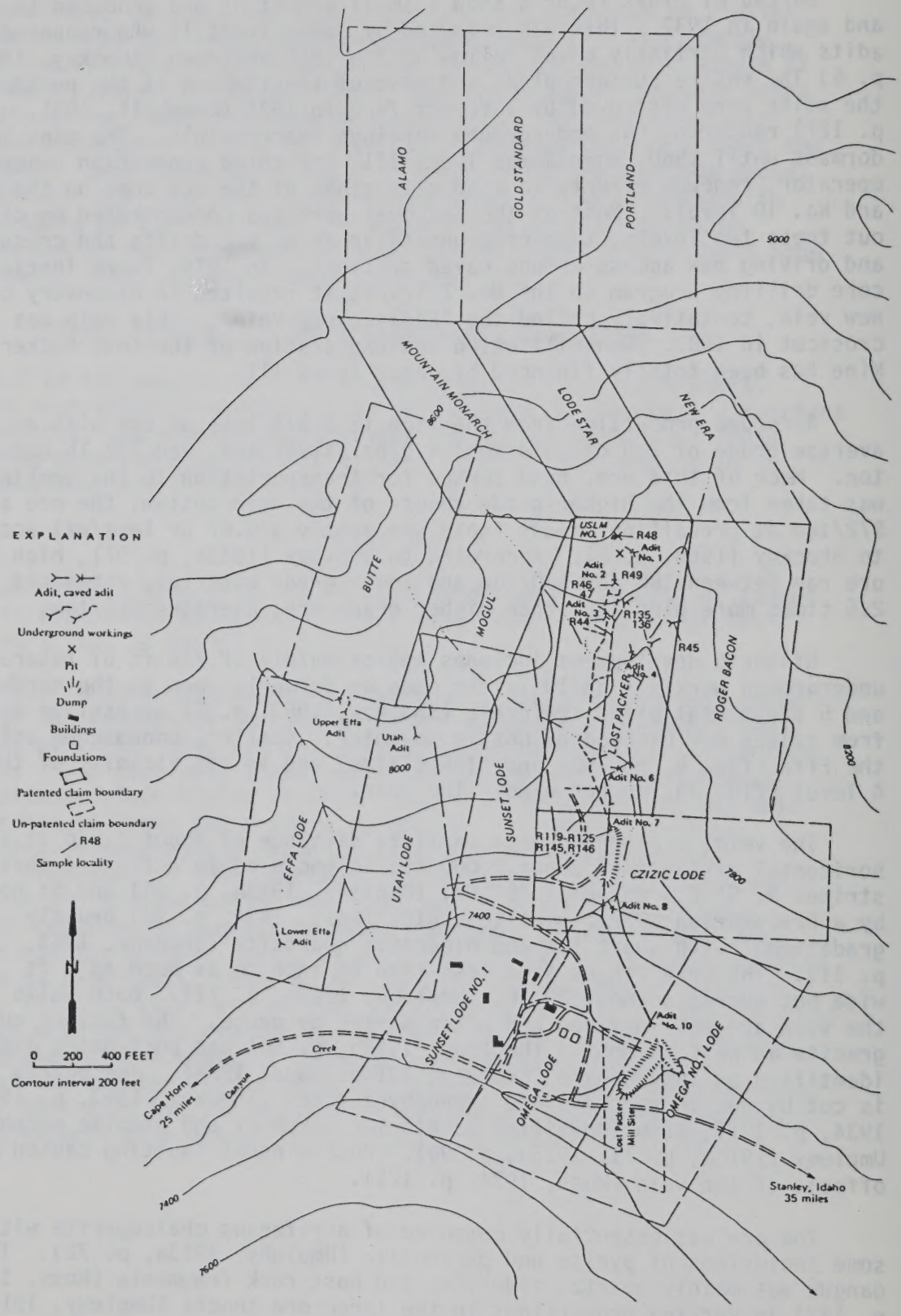


FIGURE 7.–The Lost Packer Mine and vicinity

An unnumbered table to accompany figure 7, The Lost Packer Mine and vicinity

[N, none detected; --, not analyzed]

Sample No.	Type	Length (ft)	Description	Gold (oz/ton)	Silver (oz/ton)	Copper (%)	Lead (%)	Zinc (%)
R-44	Grab--	--	Quartz-siderite-schist vein material from dump of adit no. 3; up to 10% chalcopyrite with some fragments of hematite and coatings of pyrolusite----------	0.614	1.3	3.20	0.10	0.05
R-45	Chip--	3.0	Across zone containing hematite-stained gouge, schist, quartz vein material, and leucocratic intrusive rock exposed in unnumbered adit north and east of adit no. 4.	N	.3	.17	.14	.03
R-46	do----	5.0	Across hematitic gouge zone with sheared country rock and quartz vein material; some malachite stains; left rib of crosscut in adit no. 2----------	.038	N	.38	.01	<.01
R-47	do----	3.0	As above; from face of drift in adit no. 2--	N	N	.40	<.01	.01
R-48	do----	3.5	Across hematite-stained zone at south edge of discovery outcrop pit; fractures coated with pyrolusite; vein material is vuggy with some blebs of chalcopyrite; country rock is an altered intermediate intrusive.	.054	N	.47	.10	.01
R-49	Grab--	--	Altered intrusive and schist, heavily stained with hematite and pyrolusite, sparse malachite from dump of adit no. 1.	.120	1.2	.16	--	--
R-135	Chip--	2.0	Across 2-ft-thick quartz vein on west rib of adit 50 ft from portal----------	N	.3	.285	--	--
R-136	do----	3.0	Across shear zone that strikes north and dips 65° W., 62 ft from portal of adit-----	N	N	.0078	--	--
R-145	do----	1.8	Across vein on the south rib of crosscut on no. 7 level----------	2.63	5.0	6.8	--	--
			Selected core samples 1/					
2/ R-119	Core--	.17	DDH80-11, box 9, interval = 98 ft; >50% chalcopyrite with siderite-quartz gangue, some pyrite----------	2.96	3.0	22.2	.16	N
R-120	do----	.25	DDH80-11, box 9, interval = 102 ft; >40% chalcopyrite with minor pyrite in hematite-siderite-quartz gangue----------	3.05	4.7	9.84	.22	.84
3/ R-121	do----	.17	DDH80-11, box 9, interval = 103 ft; >80% chalcopyrite plus pyrite in hematite-siderite-quartz gangue----------	1.34	5.1	28.5	.14	N
R-122	do---	.25	DDH80-3, box 7, interval = 78 ft; 25% chalcopyrite plus minor pyrite in quartz-siderite gangue----------	1.50	13.3	5.47	.31	N
R-123	do---	.25	DDH80-3, box 7, interval = 79 ft; <20% chalcopyrite in quartz-siderite gangue----	1.43	3.0	9.39	.15	.001
R-124	do---	.20	DDH79-10, box 9, interval = 94 ft; <15% chalcopyrite in siderite-quartz-hematite gangue----------	1.71	3.6	2.98	.32	N
R-125	do---	.33	DDH79-8, interval = 64 ft; <10% chalcopyrite in siderite-quartz gangue.	.32	.5	2.77	.078	N

1/ Obtained from James Ivers III (owner).
2/ R-119 sample also contained arsenic = 320 ppm; antimony = 140 ppm; mercury = 16 ppm; molybdenum = 15 ppm.
3/ R-121 sample also contained bismuth = 1750 ppm; molybdenum = 11 ppm.

The lateral and vertical extent of the "Rediscovery Vein" was not determined as of 1983. Also, it had not been determined whether this was a separate vein or a fault-displaced portion of the main vein. Analyses of sample R-145, taken from the crosscut in 1983, and samples R-119 through R-125, selected from core, indicate the tenor of this vein may be comparable to that of the main vein. Should exploration along strike on the No. 7 level and at depth on the No. 10 level define the limits of this vein, minable resources may be present.

Parker Mountain Mines

The Parker and Williams Mines (fig. 6, no. 12) are discussed jointly. The two mines are accessible via Forest Service Road 086 from Challis, Idaho. The Williams Mine on the south-facing slope of Williams Ridge has two adits; the main adit is at 8,440 ft elevation (fig. 8). Workings at the Parker Mine, on the north facing slope of Parker Ridge, range in elevation from 8,080 to 8,160 ft. There are workings on the south-facing slope of Parker Ridge that extend down to 7,680 ft but these workings are not on the main vein system of the Parker Mine.

The gold- and silver-bearing veins of the Parker Mine were claimed in 1904 and the first ore produced in 1905. Production began at the nearby Williams Mine in 1908 and both mines continued production on a regular basis until 1915 (U.S. Bureau of Mines production records). Sometime during this period a five stamp mill was constructed at the junction of Kerr and Warm Spring Creeks. Ore was transported to the mill by horse drawn sleds where it was crushed and run over a set of riffles to remove free-milling gold. The riffle tailings were run over a Fraser and Chalmers vanner to obtain a concentrate that was processed with cyanide to recover the silver and any remaining gold. Production of ore from 1908 to 1915 was 56 tons from the Williams Mine and 323 tons from the Parker Mine. The ore was high grade, yielding 658 troy oz of gold (1.7 oz/ton) and 3,490 troy oz of silver (9.2 oz/ton). The mines were worked from 1926 to 1941 on an irregular basis with about 66 tons of ore mined yielding 161 troy oz of gold (2.4 oz/ton) and 1,030 troy oz of silver (15.5 oz/ton). The ore from both mines contained free-milling gold, gold and silver as electrum, and silver in argentite (Denison Mines, Inc., 1982, personal commun.).

There was no activity at either mine site from 1941 to 1980 when Denison Mines, Inc. began preliminary evaluation of the area. Forty-four claims were located in 1980, and 37 more in 1981. Work in 1981 consisted of regional reconnaissance, geochemical surveys, and geologic mapping. In 1983, Houston International Minerals Corp., in a joint venture with Denison Mines, drilled a silver-gold geochemical anomaly near the site of the Williams Mine. About 3,000 ft of core was recovered from the six drill holes, each approximately 500 ft long. The drilling program was designed to test for a disseminated, stratabound, volcanogenic precious metal deposit. Results of the program were not made available.

Quartz veins at the Williams Mine occur in and peripheral to a north to northeast-trending zone of brecciated Challis Volcanics that is approximately 400 ft wide and can be traced along strike for 1,800 ft. The zone shows evidence of several stages of pyritization and may have been caused by an intrusive dome breaching to the surface with resultant explosive flash boiling. Dump material at the Williams Mine indicates the vein material consists of massive quartz containing pyrite and arsenopyrite.

Development at the Williams Mine consists of two adits (now caved or unsafe to enter) approximately 150 ft and 400 ft long. There are about 50 pits, open cuts and trenches of various sizes on the north and south slopes of Williams Ridge. Most of the surface workings are in the zone. Twenty samples were taken from outcrops and surface workings and results are listed in the table accompanying figure 8.

Sample analyses and observation of outcrops indicate that veins on Williams Ridge are small and only moderately mineralized, but that the zone is extensively silicified and mineralized and may contain a large-tonnage, low-grade disseminated silver/gold deposit. Houston International Minerals Corp. has discontinued their joint venture with Denison, but the latter still holds the property. Discontinuance of the joint venture by Houston International Minerals may only mean that the drilling did not indicate the existence of a large enough tonnage or high enough grade sufficient to support the scale of mining operation they envisioned. An accurate estimate of resources can not be made without subsurface information.

Quartz veins at the Parker Mine are in two fault zones: one strikes N. 10 W., and dips 40° to 60° E. (fig. 8), and the other strikes N. 20 E., and dips 70° to 80° E. The individual quartz veins are principally dark gray or black and exhibit several stages of emplacement as indicated by banding, cockscombs, and needle-like intergrowths. The rhyolite host rock is intensely brecciated and extensively silicified. Gold and silver in the quartz veins and rhyolite breccia occur as small masses (generally <1/4 in. diameter) of argentite with small grains of gold visible under microscopic examination. The argentite and gold also occur as distinct grains disseminated randomly throughout the siliceous matrix.

The Parker Mine consists of about 15 adits, most of which are caved. Five adits, totaling about 800 ft of underground development, were mapped and sampled during this study. Additionally, there are about 40 pits or open cuts on the north and south slopes of Parker Ridge. Analyses of 36 samples taken from outcrops and workings at the Parker Mine and vicinity are listed in the tables accompanying figures 9 and 10. The 7680 Adit is not presented as a separate figure because no significant structures were observed and it is not on the main vein system.

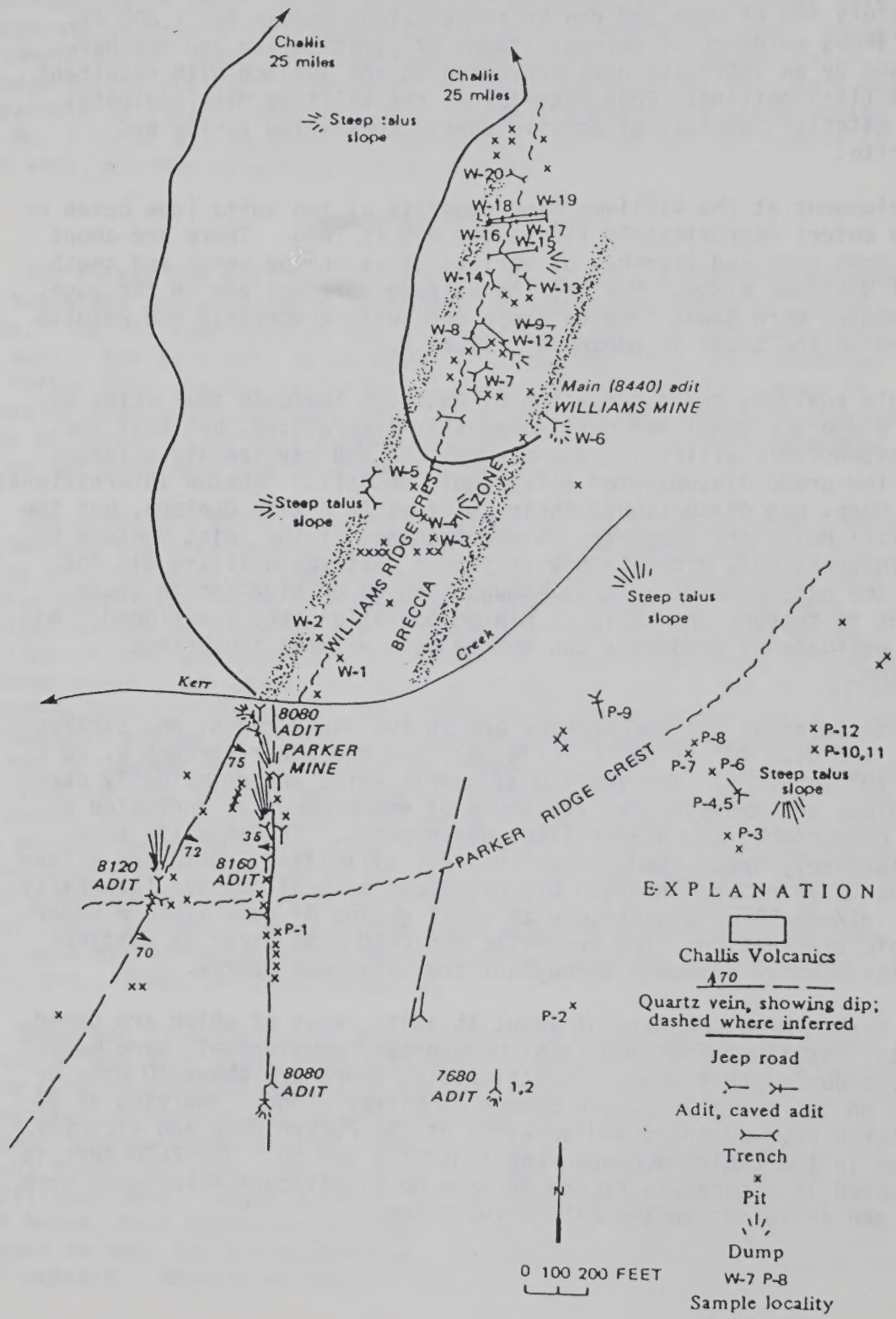


FIGURE 8.—Parker and Williams Mines

An unnumbered table to accompany figure 8, Parker and Williams Mines

[N, none detected]

Sample No.	Type	Length (ft)	Description	Gold (oz/ton)	Silver (oz/ton)
			Surface Samples - Williams Mine Area		
W-1	Grab--	--	Brecciated, silicified lithic tuff	0.001	0.04
W-2	do----	--	do----------	.002	.04
W-3	do----	--	Welded tuff with carbonaceous material----------	N	N
W-4	do----	--	Tuff----------	N	N
W-5	do----	--	Silicified tuff with minor carbonaceous material----------	N	N
W-6	do----	--	Silicified tuff and rhyolite breccia----------	N	N
W-7	do----	--	Silicified tuff with carbonaceous material----------	N	.2
W-8	do----	--	Silicified tuff with minor banding----------	N	.3
W-9	Chip--	0.3	Shear zone in volcanic breccia---	N	N
W-10	Grab--	--	Volcanic breccia with minor shear zones----------	.118	1.2
W-11	do----	--	Grab of stockpile - tuff, volcanic breccia and quartz; vuggy with minor disseminated pyrite-------	2.646	11.4
W-12	do----	--	Grab of stockpile - silicified breccia with carbonaceous material----------	N	5.8
W-13	Chip--	.8	Rhyolite breccia with quartz veins	N	N
W-14	Grab--	--	Rhyolite breccia with carbonaceous material----------	N	.2
W-15	do----	250 ft at 5 ft intervals	Brecciated, silicified tuff with minor quartz veins----------	.05	2.7
W-16	Chip--	150 ft at 5 ft intervals	Silicified brecciated tuffs-------	.003	.05
W-17	do---	do----- at 5 ft intervals	Brecciated silicified tuff with minor sulfides----------	.009	.07
W-18	do---	100 ft at 3 ft intervals	Brecciated, silicified tuff-------	N	N
W-19	Grab--	--	Lithic tuff with numerous quartz stringers to 1/8 in. thick-------	N	N
W-20	Chip--	18.0	Brecciated tuff----------	.065	5.7

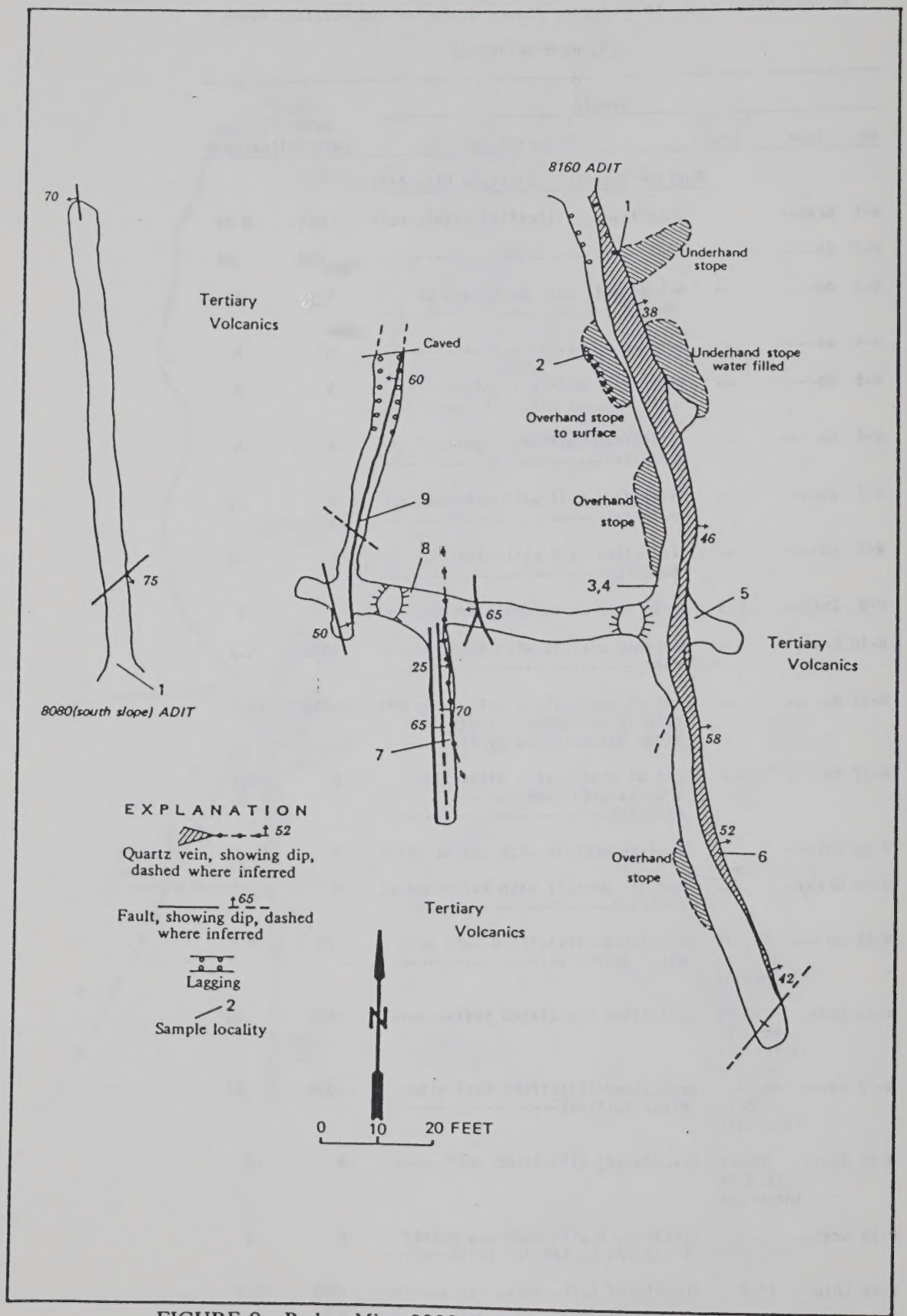


FIGURE 9.—Parker Mine 8080 (south slope) and 8160 adits

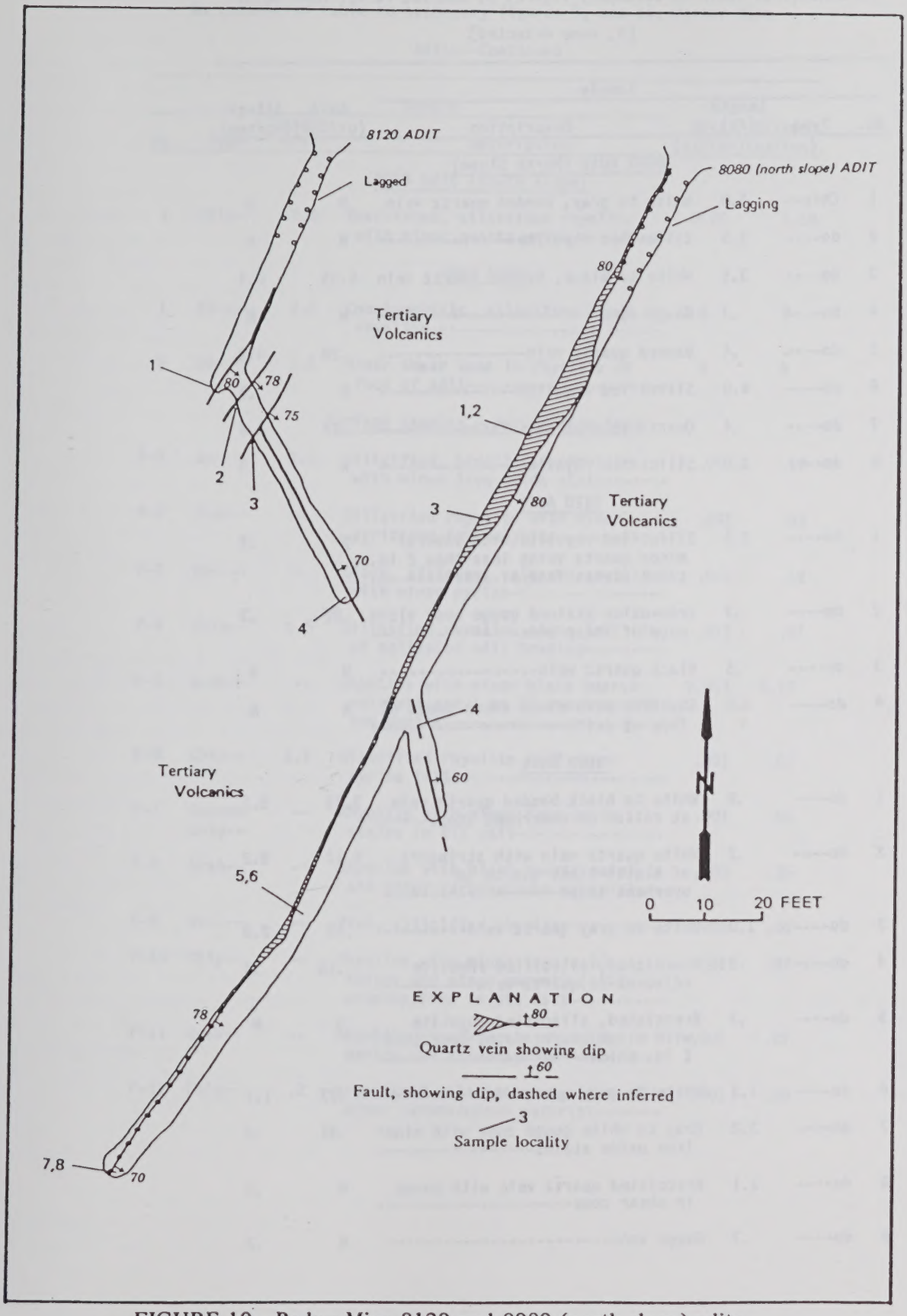


FIGURE 10.–Parker Mine 8120 and 8080 (north slope) adits

An unnumbered table to accompany figures 9, and 10, Parker Mine Adits

[N, none detected]

Sample No.	Type	Length (ft)	Description	Gold (oz/ton)	Silver (oz/ton)
			8080 Adit (North Slope)		
1	Chip--	1.0	White to gray, banded quartz vein	N	N
2	do----	3.5	Silicified rhyolite----------	N	N
3	do----	3.5	White to black, banded quartz vein	0.05	0.4
4	do----	.3	Gouge zone----------	N	N
5	do----	.4	Banded quartz vein----------	.28	4.2
6	do----	4.0	Silicified rhyolite----------	N	.3
7	do----	.4	Quartz vein at adit face----------	.17	4.6
8	do----	3.0	Silicified rhyolite----------	N	.4
			8120 Adit		
1	do----	3.5	Silicified rhyolite with several minor quartz veins less than 2 in. thick across face of drift--------	N	.2
2	do----	.3	Iron-oxide stained gouge zone along edge of shear zone----------	.02	.3
3	do----	.5	Black quartz vein----------	N	N
4	do----	3.0	Rhyolite with minor shear zones at face of drift----------	N	N
			8160 Adit		
1	do----	.8	White to black banded quartz vein at collar of underhand stope------	3.75	5.1
2	do----	.2	White quartz vein with stringers of bluish-black quartz in overhand stope----------	6.12	9.2
3	do----	1.0	White to gray quartz vein---------	.45	2.8
4	do----	.3	Brecciated, silicified rhyolite adjacent to quartz vein----------	.10	.4
5	do----	.3	Brecciated, silicified rhyolite with minor quartz veins less than 1 in. thick----------	N	N
6	do----	1.3	White to gray quartz vein---------	.27	1.1
7	do----	3.0	Gray to white gouge zone with minor iron oxide stains----------	.01	.4
8	do----	1.1	Brecciated quartz vein with gouge in shear zone----------	N	.2
9	do----	.3	Gouge zone----------	N	.2

An unnumbered table to accompany figures 9, and 10, Parker Mine

Adits--Continued

Sample No.	Type	Length (ft)	Description	Gold (oz/ton)	Silver (oz/ton)
			8080 Adit (south slope)		
1	Chip--	1.5	Brecciated, silicified rhyolite with minor quartz veins----------	0.26	1.58
			7680 Adit		
1	do----	2.5	Conglomeritic, silicified birds eye rhyolite----------	N	N
2	do----	3.5	Minor shear zone in rhyolite at face of adit----------	N	N
			Surface Samples - Parker Mine Area		
P-1	do----	3.5	Silicified, brecciated rhyolite with minor iron oxide stains------	.003	.19
P-2	Grab--	--	Silicified rhyolite with minor pyriteand arsenopyrite----------	.001	.05
P-3	do----	--	Black, siliceous, altered argillite with minor pyrite----------	.007	.12
P-4	Chip--	5.5	Silicified rhyolite along left rib of collapsed adit heading---------	.015	.07
P-5	Grab--	--	Rhyolite with minor black quartz veinlets and 1 to 2% arsenopyrite and pyrite----------	0.017	0.13
P-6	Chip--	2.1	Silicified rhyolite tuff minor pyrite (<1%)----------	.001	.03
P-7	Random chip--	--	Rhyolite with minor iron-oxide stains in pit wall----------	.001	.06
P-8	Grab--	--	Rhyolite with black quartz veinlets and minor carbonaceous material---	.002	.26
P-9	do----	--	Pink, silicified rhyolite---------	.001	.06
P-10	Chip--	--	Rhyolite with minor iron oxide stains and minor amounts (<1%) arsenopyrite in pit wall----------	.001	.07
P-11	Grab--	--	Rhyolite microbreccia with <1% pyrite and arsenopyrite----------	.001	.07
P-12	Chip--	.2	Brecciated silicified rhyolite with minor carbonaceous material-------	.001	.20

Some sample analyses from the Parker Mine contained high gold and silver values, and indicate minable resources may be present in vein segments. The average historical ore grade mined from the Parker Mine for the two distinct periods of production ranged from 1.7 to 2.4 oz/ton gold and 9.2 to 15.5 oz/ton silver. Of the 22 samples taken from underground workings at the mine, six contained more than 0.25 oz/ton gold and two contained 3.75 and 6.11 oz/ton. The two major fault zones containing the veins crop out on the crest of Parker Ridge and are exposed in underground workings near the base of the north side of the ridge slope. Vertical extent of the exposed fault zones is 250 ft and the horizontal extent is about 1,200 ft. Thickness of the individual quartz veins exposed in underground workings ranges from 8 ft to less than 1 in. Because of the variability of the vein thickness and length, the sporadic distribution of veins, and the heterogeneity of the mineral content, no accurate estimates of tonnage or grade can be made for the two main zones on Parker Ridge.

Monte Cristo Mine

The Monte Cristo Mine (fig. 6, no. 35) is on the north side of Mayfield Creek about 1 mile due east of the Diamond D (Boyle) Ranch. Access to the lower adit, at an elevation of approximately 7,000 ft, is by foot trail from the north bank of the creek.

The exact location date of the first claims on the Monte Cristo property is not known. Ross (1934, p. 118) stated that work began at the mine in 1917. By 1924, two adits had been driven a total of 488 ft (Campbell, 1924, p. 106). Simons (1934, p. 142) reported the adits had been driven a total of 1,790 ft, and in 1934, Campbell (1935, p. 173) reported that the Monte Cristo Gold Mines Co., Inc. had forfeited their charter. A notice found on the property in 1982 indicates a claim, known as the Lost Poet, was located in 1944 by Nels D. Johnson. A letter, received in 1982 from his widow, stated she had willed the Lost Poet claims to the Church of Jesus Christ of the Latter Day Saints. A copy of an undated report obtained from Mrs. Johnson through the First Eagle Corp., current lessee, indicates the property was developed by Clarence E. Eddy, an early prospector in the Loon Creek district. This report, largely promotional in nature, indicates development far in excess of that reported to the State Mine Inspector, as indicated above. However, Eddy reported three main adits on the property; all are now caved and unsafe to enter (fig. 11). When Ross (1934, p. 125) visited the property in 1925, the lower adit was about 700 ft long and the upper or main adit was caved a short distance in from the portal. Bureau of Mines records do not show any production from the Monte Cristo Mine.

The mine is in a small pendant of Precambrian chlorite-muscovite schist underlain by Cretaceous quartz monzonite (Fisher and others, 1983). A rocky soil covers most of the area; no outcrops occur in the immediate vicinity of the mine workings. Material found on the dump of the main adit indicates one or more quartz veins were intersected. It is not possible to determine the dimensions of the veins but some quartz specimens appear to be as thick as 1 ft. Some of the quartz is vuggy, translucent, and stained with hematite, and appears to have been deposited in an open structure; other specimens are milky white and massive, and appear to be relatively barren of sulfide minerals and metallic oxides. The more massive quartz was also found on the dump of the lower adit but not the vuggy, iron-stained type. Analyses of samples are in the table accompanying figure 11.

Ross (1934, p. 125) states that the upper or main adit reportedly contains the vein which the lower adit was driven to intersect. Because the vein does not crop out on the surface, a survey grid was established to test, by geochemical and geophysical methods, for possible continuity of the system between the ridge crest and the lower adit (fig. 11). Soil samples were collected and very-low frequency electromagnetic (VLF-EM) and total field proton magnetometer readings were taken at 20-ft intervals along each of six survey lines.

Soil samples were analyzed for gold, silver, copper, lead, zinc, fluorine, and arsenic. Gold, silver, and copper were chosen as target elements because these are part of an assemblage common to deposits in the region hosted by Precambrian metasedimentary rocks; lead, zinc, fluorine, and arsenic were chosen as indicator elements because of their presence in some of the samples taken from dumps of the caved workings. Gold, silver, and zinc anomalies were established as any amount above the detection limits of 0.01, 0.7, and 1 part per million (ppm), respectively; copper, lead, and arsenic anomalies were defined as at least one positive standard deviation from the mean value of each element. Only two sample sites (3-60W and 4-60W) show anomalous gold and silver together (fig. 11). Site 4-60W also shows anomalies for copper, lead, and zinc, and is the strongest indication of a possible subsurface vein.

The gold-silver anomalies are interpreted as representing the approximate position of the vein which was the target of historic mining activity; adjacent anomalies, exclusive of 4-60W, possibly represent a halo around the system. If these assumptions are correct, the vein system appears to be limited to the area between lines 2 and 5. Of secondary importance are persistent zinc anomalies on the east end of lines 3 through 6 with a possibility of extending to site 2-40E. This could either represent a separate vein or the effects of weathering of any galvanized metal used in the vicinity of the main adit.

VLF-EM dip angle readings did not show any patterns indicative of a moderate to strong conductor and magnetic field strength readings did indicate any patterns of magnetic contrast that could be interpreted as the vein or a vein system.

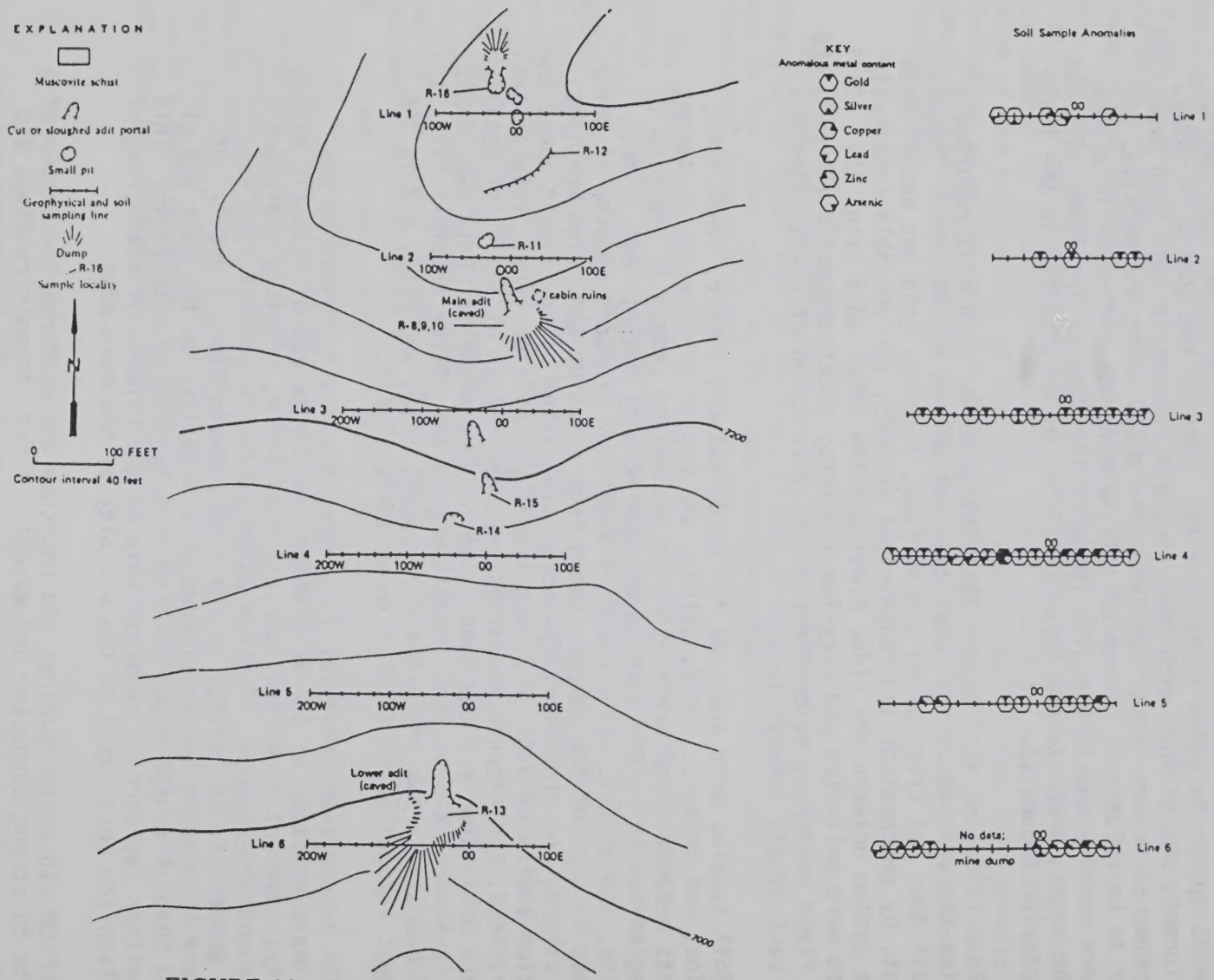


FIGURE 11.--Sample sites and soil sample anomalies on the Monte Cristo Mine

Unnumbered table to accompany figure 11, Monte Cristo Mine

[N, none detected; --, not determined]

Sample No.	Type	Length (ft)	Description	Gold (oz/ton)	Silver (oz/ton)	Copper (%)	Lead (%)	Zinc (%)
R-8	Grab--	--	Heavily iron-oxide-stained, vuggy quartz with sulfide boxwork----------	0.344	1.9	0.10	0.18	0.04
R-9	do----	--	Lightly iron-oxide-stained bull quartz; no visible sulfides or boxwork-------	N	N	N	.01	.01
R-10	do----	--	As in R-8----------	--	--	.20	8.46	.53
R-11	do----	--	Moderately to heavily iron-oxide-stained quartz and schist----------	N	N	.02	.01	.01
R-12	do----	--	do----------	.020	N	.01	.02	N
R-13	do----	--	Light to moderately iron-oxide stained quartz with about 2% fine-grained pyrite and possible arsenopyrite------	N	N	N	N	N
R-14	do----	--	Moderately to heavily iron-oxide-stained quartz and schist with minor boxwork and fine-grained pyrite altered to limonite----------	.078	.02	.01	.04	N
R-15	do----	--	Heavily iron-oxide-stained quartz with medium to fine-grained pseudomorhhs of limonite after pyrite in vugs----------	.160	.04	.06	.01	.01
R-16	do----	--	Moderately iron-oxide-stained quartz; no visible sulfides, minor pyrite boxwork----------	N	N	.01	.14	.02

Zeolite Occurrences

Several outcrops of zeolitized tuffs, some of which are very large in areal extent and exhibit considerable thickness, occur in the Loon Creek-Warm Spring Creek unit. Zeolites are crystalline hydrated aluminosilicates that form generally as the result of the reaction of hydrothermal solutions or ground water on volcanic glass, plagioclase feldspar, nepheline, and quartz. Tuffs containing a significant percentage of zeolites are used in industry for a wide variety of applications, including molecular sieves for gases and liquids, in petroleum distillation (cracking), food supplements for livestock, soil additives or conditioners, fillers in fertilizers and insecticides, and in pollution control.

There are no industry standards detailing the specific physical requirements that constitute "ore grade material" for zeolite-bearing tuffs. Generally, the zeolite-bearing material should contain more than 70% zeolites and most of the total zeolite content should be composed of a single zeolite mineral. Quite often a zeolite-bearing rock is discovered and then an industrial application is found for that particular zeolite based on numerous additional tests, such as cation exchange capacity and pore size.

Samples were taken from four sites (fig. 6, nos. 11, 14, 15, and 16) and analyzed for the type and percent of zeolite present. The zeolite-bearing tuffs that comprise the ridge southeast of Parker Mountain (fig. 6, no. 11) represent the largest deposit of zeolite-bearing tuffs in the unit. The ridge is about 3,000 ft long and tuffs are exposed continuously along it. Additionally, the tuffs crop out vertically on the ridge slopes for approximately 600 ft. Two 300-ft-long chip samples taken along the ridge crest contained 40% and 30% clinoptilolite and 20% mordenite.

The samples were analyzed only for the presence and types of zeolites. In order to determine if the zeolite occurrences constitute a resource, they would have to be tested in terms of the proposed use.

Meyers Cove Fluorspar Occurrences

Fluorspar (fluorite) deposits at Meyers Cove occur locally as discontinuous pods and lenses along northeast-striking fissures in Challis Volcanics in close proximity to outcrops of late Tertiary intrusive rocks. Emplacement of the fluorite was accompanied by silica, barite, and stibnite as at the Lora-Eletha claims (fig. 6, no. 4). The fissure zones are generally several hundred feet long but some can be traced for several thousand feet. The discontinuous pods of fluorspar average about 100 ft long, 4 to 6 ft thick, and extend downdip about 100 ft. Some pods (Big Lead and Antler Ridge) are 200 to 300 ft long, 16 ft thick, and extend 200 to 300 ft downdip.

Fluorite-bearing zones extend southwesterly into the Wilderness, but are apparently not as large as those northeast of Camas Creek. Known fluorspar pods southwest of Camas Creek are less than 1 ft thick and only a few feet long. These occurrences are in resistant outcrops of silicified, porphyritic rhyolite or granophyre.

Because of the steep, heavily-forested slopes, the area has not been explored sufficiently to determine the extent of the terrane favorable for fluorspar occurrences. The close proximity to the developed deposits east of Camas Creek and the similarity of rock types and structures indicates that fluorspar bodies similar to those found east of the creek may exist in the Loon Creek-Warm Spring Creek unit. Chip samples taken from outcrops west of Camas Creek contained 41%, 36%, and 1.8% fluorite (see fig. 6, nos. 3, 1, and 2, respectively).

Hot Creek Fluorspar Occurrence

The Hot Creek fluorspar occurrence (fig. 6, no. 7) is on the west side of Hot Creek about 600 ft northwest of its confluence with Warm Spring Creek. Access to the site is by trail from Transfer Campground on Loon Creek, a distance of approximately 10 miles, or by trail that heads on the Sleeping Deer Mountain road and leads about 12 miles to the mouth of Hot Creek. Elevation of the zone is about 5,900 ft.

Ross (1934, p. 130) described the site as one of a series of fault zones in Challis Volcanics that contained small gash veins of fluorite and fine-grained banded quartz and sparsely disseminated cubes of pyrite. The fault zone, as shown by Ross (Plate 1), extends for about 2.5 miles along lower Hot Creek and into Cold Creek. Fisher and others (1983) mapped the rock unit as the tuffs of Challis Creek-Black Mountain, but do not show the fault zones as mapped by Ross.

A 3-ft continuous chip sample taken across a fluorite-bearing gash fracture, contained only 0.051% fluorite (CaF_2). However, the sample assayed 0.29 oz/ton gold and 160.7 oz/ton silver. Because of the erratic nature of these gash veins, resources are impossible to calculate. Assuming other gash veins containing similar anomalous precious-metal values are present along the length of the fault zone, this structure warrants further study.

Vanity Ridge Prospects

Vanity Ridge separates the northeast flowing Baldwin and Vanity Creeks. The road from Cape Horn along Beaver Creek to the Seafoam Guard Station provides the only access.

Numerous prospects (Lowe and others, 1983, fig. 4) are located along the ridge crest and its east flank, just outside the wilderness boundary. Elevations of these prospects range from 7,000 ft to about 9,200 ft. Among these prospects are the Betty Ruth, Wild Buck, Canary Yellow, and the Long Shot Nos. 1-3 Claims (fig. 6, nos. 86, 88, and 90, respectively). Collectively, these occur in shear zones in granodiorite, along the contacts between the granodiorite and dacite and leucocratic quartz monzonite dikes, and at contacts between metasedimentary rock remnants and the granodiorite. The host granodiorite and dikes have been mapped by Bennett (1981).

Notices found in the vicinity indicate the claims were located at least as early as 1948; more recent records show the claims re-located in 1981. There is no history of activity or production. Several adits are caved, some of which may have been as long as several hundred feet.

Figure 12 shows the location of these workings and sample sites. Unique to mines and prospects in the Seafoam mining district is the anomalously high gold and silver values in most of the samples, as shown in the table accompanying figure 12. Although no resources could be calculated, the precious metal values of the samples indicate the prospects warrant further investigation.

ASSESSMENT OF MINERAL RESOURCES

Most of the mines and prospects examined in and near the Loon Creek-Warm Spring Creek unit are considered as occurrences, mainly because of the apparent lack of substantial resources.

Mines and prospects that may contain base and/or precious metal resources include the Lost Packer, Parker and Williams Mountain Mines outside the Wilderness. Samples of a newly discovered vein on the No. 7 level of the Lost Packer Mine indicate the gold, silver, and copper contents are nearly identical to ore produced in the early 1900's. Several samples of the Parker Mine vein system indicate silver-gold resources may be present. Drilling data is needed on the Williams Mine to determine the size, grade, and mining feasibility of a disseminated precious metal deposit. The Monte Cristo Mine, inside the Wilderness, may have silver-gold resources, but they are likely to be limited because of the small size of the host rock pendant. Samples from prospects outside the study area on the west side of Vanity Creek indicate precious metal resources may be present, principally at the Betty Ruth, Wild Buck, Canary Yellow, and Long Shot Claims.

Some prospects in the Meyers Cove area contain fluorspar deposits but these are small and distant from current markets. Zeolite-bearing tuffs occur at several sites in the eastern half of the unit; further testing might be warranted if higher concentrations of zeolites are found at these localities. Known mineralized areas near the mouth of Hot Creek need to be evaluated in detail to determine the extent of anomalous values indicated by limited sampling.

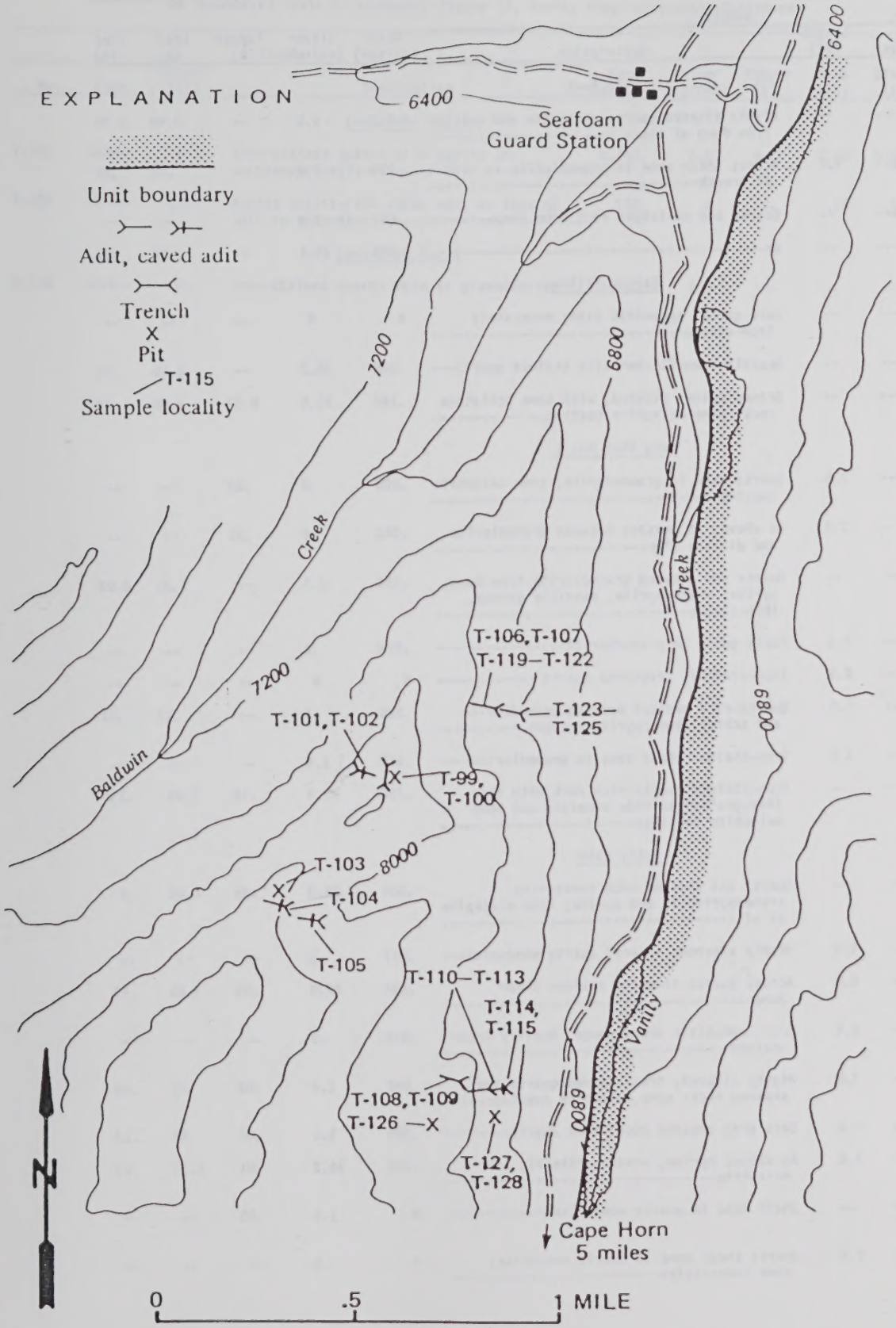


FIGURE 12.—Vanity Ridge prospects

An unnumbered table to accompany figure 12, Vanity Ridge Prospects

[N, none detected; --, not analyzed]

Sample No.	Type	Length (ft)	Description	Gold (oz/ton)	Silver (oz/ton)	Copper (%)	Lead (%)	Zinc (%)
			Wild Buck					
T- 99	Grab--	--	Highly altered quartz monzonite and quartz from dump of pit----------	0.026	5.0	--	0.40	0.03
T-100	Chip--	5.0	Across shear zone in granodiorite at face of trench----------	.038	2.8	--	.60	.02
T-101	Grab--	--	Quartz and schistose rock from dump--------	.022	1.8	--	--	--
T-102	do----	--	do----------	.116	25.4	--	1.26	.03
			Canary Yellow					
T-103	do----	--	Dark green, aphanitic dike; moderately iron-stained----------	N	N	--	--	--
T-104	do----	--	Heavily limonite-hematite stained quartz---	.086	48.2	--	8.10	.20
T-105	do----	--	Granodiorite, altered, with some schistose rock; some malachite coating----------	.166	61.0	0.62	7.90	.42
			Long Shot No. 1					
T-108	Chip--	2.5	Quartz vein in granodiorite; some malachite coatings----------	.028	.8	.03	--	--
T-109	do----	2.0	As above; at contact between granodiorite and diabase dike----------	.040	.6	.03	--	--
T-110	Grab--	--	Quartz and altered granodiorite from dump; pyrite, arsenopyrite, possible galena, iron-stains----------	.316	2.7	--	1.21	0.03
T-111	Chip--	5.5	Fault gouge in granodiorite----------	.018	.2	--	--	--
T-112	do----	2.5	Iron-stained, fractured quartz----------	N	N	--	--	--
T-113	do----	1.5	Quartz-rich contact between granodiorite and schist, some pyrite present----------	.126	.7	--	.17	.01
T-114	do----	3.5	Iron-stained shear zone in granodiorite----	.120	1.6	--	--	--
T-115	Grab--	--	Iron-stained quartz-rich rock with very fine-grained sulfide minerals and some malachite coatings----------	.756	12.4	.10	7.90	.13
			Betty Ruth					
T-106	do----	--	Quartz and sheared rock containing arsenopyrite(?) and pyrite; from stockpile at adit----------	.204	28.0	.05	6.60	.2
T-125	Chip--	6.0	Highly altered, sheared quartz monzonite---	.017	.5	--	--	--
T-107	do----	8.0	Across quartz-limonite stained shear zone----------	.164	29.0	.05	3.65	.13
T-119	do----	2.5	Gray, aphanitic shear gouge, heavily iron-stained----------	.016	.9	--	--	--
T-120	do----	3.0	Highly altered, iron-stained quartz and sheared rock; some malachite coating------	.042	1.4	.02	.42	.08
T-121	do----	2.5	Dark gray sheared rock; some quartz--------	.006	1.1	.01	.22	.13
T-122	do----	4.0	As above; pyrite, arsenopyrite(?), and malachite----------	.126	16.2	.01	1.13	.03
T-123	Random chip--	--	Shear zone in quartz monzonite----------	N	1.5	.05	--	--
T-124	Chip--	2.5	Quartz shear zone in quartz monzonite; some iron-stains----------	N	.5	--	--	--

An unnumbered table to accompany figure 12, Vanity Ridge prospects--Continued

Sample No.	Type	Length (ft)	Description	Gold (oz/ton)	Silver (oz/ton)	Copper (%)	Lead (%)	Zinc (%)
			Long Shot No. 2					
T-127	Chip--	--	Iron-stained quartz with pyrite and arsenopyrite(?)----------	0.118	7.9	0.07	7.70	0.03
T-128	do----	5.0	Across quartz-rich shear zone at face of pit in granodiorite----------	.134	.9	--	.17	.1
			Long Shot No. 3					
T-126	Grab--	--	Iron-stained quartz vein in granodiorite---	1.110	1.0	--	--	--

Table 2.--Mines, prospects, claims, and mineralized areas in the Loon Creek-Warm Spring Creek Unit

[Asterisk (*) indicates outside study area]

Map no.	Name	Geology	Workings and production	Sample and resource data
1	Purple Spar No. 2 Claim	Euhedral fluorite in cavities and fracture fillings up to 1 ft thick in rhyolite porphyry. Porphyry is silicified and forms a prominent outcrop on ridge slopes.	None	One chip sample: 73.9% fluorite (CaF_2).
2	Fluorspar occurrence	Finely crystalline fluorite in veins up to 3 in. thick along fractures in rhyolite porphyry.	None	One chip sample: 3.7% fluorite and 0.22% barite.
3	Lucky Herb Claim	Crystalline fluorite occurs in fractures up to four in. thick in rhyolite porphyry. Outcrop is highly silicified and forms a prominent spine on slope of ridge.	None	One chip sample: 84.3% fluorite and 0.03% barite.
4	Lora-Eletha Claim (Meyers Cove Antimony)	Hydrothermally altered shear zone in andesite porphyry is silicified and contains fluorite, barite, and stibnite. The zone strikes N. 70° E. and dips from 40° to 45° NW (Anderson, 1943, p. 16) and is intermittently exposed by cuts for about 500 ft (Cox, 1954, p. 19)	Four open cuts, one with a large loading landing. Production unknown.	Five chip samples contained 0.28%, 0.57%, 8.8%, 19.5% and 41.1% fluorite; 0.1%, 0.14%, 2.5%, 3.9%, and 8.2% antimony; 0.21%, 0.57%, 9.92%, 13.31%, and 17.09% barite; 0.05, 0.06, 0.07, and 0.08 oz/ton gold; and 0.1, 0.2, 0.5 and 0.6 oz/ton silver; no gold or silver detected in one sample.
5	Fluorspar occurrence	Rhyolite tuff, lithic tuff and andesite have numerous fluorite-filled fractures.	None	Four samples: two chip samples contained 21% and 23% fluorite and two grab samples contained 47% and 0.27% fluorite; no gold or silver detected.
6	Fluorspar occurrence	Rhyolite tuff and andesite contain massive quartz breccia and quartz veins with minor disseminated arsenopyrite and fluorite veinlets.	None	Three chip samples of breccia and one grab sample: one sample contained 39% fluorite; no gold or silver detected.
7	Hot Creek Fluorspar occurrence	See text.		
8	Massacre Mercury Claim	Prospects at river level in heavily altered andesite and the prospects on the ridge crest are in phyllite in the altered andesite country rock. Andesite contains discrete grains and small blebs of disseminated pyrite and arsenopyrite. The upper workings are on a narrow shear zone that strikes N. 55° E. and dips 85° S.	Two caved adits, probably less than 50 ft long, a 15 ft long adit and three sloughed cuts.	One chip and one grab sample: no mercury was observed. Four samples taken by the Bureau of Mines (1943) contained no more than 0.4 lb/ton mercury.

Table 2.--Mines, prospects, claims, and mineralized areas in the Loon Creek-Warm Spring Creek Unit--Continued

Map no.	Name	Geology	Workings and production	Sample and resource data
9	Prospect	Challis Volcanics have local occurrences of vitrophyre.	Four pits.	One grab sample: no gold or silver detected.
10	Last Chance Claim	Rhyolite flow has pyrite-bearing nodules. The nodules range from two to fifteen in. in diameter and some have pyrite cores often altered to hematite-limonite.	None	One chip sample: no gold or silver detected.
11	Zeolite occurrence	See text.		
12	Parker Mine/ Williams Mine *	See text.		
13	Tip Group Claim	Rhyolite porphyry contains disseminated pyrite and arsenopyrite.	One sloughed trench.	One grab sample: 0.2 oz/ton silver; no gold detected.
14	Zeolite occurrence	Outcrop of altered tuff.	None	One sample: 55% clinoptilolite.
15	Zeolite occurrence	See text.		
16	Zeolite occurrence	See text.		
17	Prospect *	Light greenish-gray welded tuff.	Two small pits.	One chip sample: no gold or silver detected.
18	Prospect *	Welded rhyolite tuff has minor iron-oxide stains.	Four small pits.	Two chip samples: no gold or silver detected.
19	Prospect *	Silicified tuff has minor iron-oxide and manganese oxide stains.	Eight small pits.	Two chip samples: no gold or silver detected.
20	Prospect *	Light gray, siliceous tuff which locally contains felsic dikes and shear zones with minor pyrite.	Two adits, 85 and 60 ft long, and two pits.	Four chip samples of shear zones: no gold or silver detected.
21	Prospect *	Siliceous, rhyolitic tuff has minor iron oxide and manganese oxide stains.	One adit 23 ft long and a small pit.	One chip sample: 0.3 oz/ton silver; no gold detected.
22	Prospect *	Quartz monzonite cut by small zone which is hydrothermally altered and contains minor amounts of specular hematite.	One shaft about 6 ft deep.	One chip sample: no gold or silver detected.
23	Prospect	Iron-oxide-stained siliceous tuff.	Three small pits.	One chip sample: no gold or silver detected.
24	Wangler Group Claims	Brecciated silicified rhyolite intruded by basic dikes and capped by basalt flows. Minor pink fluorite and calcite are in breccia zone.	None	Three chip samples: one sample contained 1.9% fluorite.

Table 2.--Mines, prospects, claims, and mineralized areas in the Loon Creek-Warm Spring Creek Unit--Continued

Map no.	Name	Geology	Workings and production	Sample and resource data
25	Fluorspar occurrence	Fault zone strikes N. 40° E., and dips 55° NW in andesitic flows juxtaposes east and west dipping units on either side of the fault. The portion of the zone sampled is about 2.5 ft thick and is comprised of host rock, fluorspar, and some cryptocrystalline silica. The fluorspar occurs as clear to pale-yellow and pale-green cubes and octahedra ranging from microcrystalline druses to about 1/8 in. in size. It occurs in fractures as seams and veinlets ranging from <1/16 in. to about 1/2 in. thick over the 2.5 ft thick zone. The zone may be an extension of the Lamb Prospect (Choate, 1962, p. 89-90).	None	One chip sample contained 41% fluorite (CaF_2).
26	Spotted Bear Claim*	Quartz monzonite has xenoliths of argillite locally exhibiting phyllitic to schistose texture.	Four pits and two caved adits less than 50 ft long.	Four chip samples and one grab sample of argillite: one sample contained 0.42% copper.
27	Prospect	Quartz monzonite has xenoliths of metasedimentary rock.	One 20-ft-long adit.	One chip sample of metasediment: no gold or silver detected.
28	Prospect	Metasedimentary rock xenolith in quartz monzonite. Lower pit is in schist. Upper pit in schist and just below granite/volcanic rock contact.	Three small pits, two are sloughed.	One chip sample and two grab samples of schist The chip sample had 0.056 oz/ton gold, 1.5 oz/ton silver, and 1.96% copper.
29	ARMP Claims*	Quartz monzonite contains quartzite and phyllite zenoliths.	None	Two chip samples, one of quartzite the other of phyllite: no gold or silver detected.
30	Misty Mountain Claim	Heavily iron-oxide-stained, silicified felsite.	None	One chip sample: no gold or silver detected.
31	Blue Lady Claim	Quartz monzonite contains minor quartz-filled fissures and numerous metasedimentary xenoliths with malachite and azurite halos. A fissure vein exposed at the adit portal is 2.8 ft thick and has malachite, azurite, chalcopyrite, bornite, pyrite and arsenopyrite. The vein strikes N. 42° E and dips 62° NW.	One adit about 10 ft long.	Two chip samples: 0.1 and 0.2 oz/ton silver, 0.96% copper; no gold detected.
32	Prospect	Schist, gneiss, and quartzite intruded by rhyolite and andesite dikes.	Two small cuts totaling 5 ft long.	Two chip samples of gneiss: no gold or silver detected.

Table 2.--Mines, prospects, claims, and mineralized areas in the Lotn Creek-Warm Spring Creek Unit--Continued

Map no.	Name	Geology	Workings and production	Sample and resource data
33	Billy Goat (Ridge Runner) Claims	Quartz monzonite of the Idaho batholith contains multiple shear zones with quartz veins up to 2 ft thick. Structures strike N. 43° to 59° W. and dip 47° to 72° SW. Iron-oxide-stained, silicified fault zones with sulfide minerals and malachite.	Three adits 120, 47 and 18 ft long.	Ten chip and three grab samples of quartz vein material: two of three grab samples contained 1.87 and 0.092 oz/ton gold and one sample contained 4.7 oz/ton silver. The three grab samples contained 4.7 oz/ton silver and 0.41%, 0.13% and 0.08% copper. Only two of the ten chip samples contained 0.11 and 1.36 oz/ton gold and 0.4 and 0.3 oz/ton silver. Copper content ranged from none detected to 0.13% in 8 samples.
34	Lucky Star Claim	Monzonite has numerous fractures and shear zones that strike N. 30° to 45° W. and dip 75° NE. to vertically. The shear zones are 1 to 2 ft thick and contain minor amounts of pyrite, chalcopyrite and arsenopyrite. Caved adit has a 3 to 4 ft thick quartz-filled fault zone that contains up to 10% pyrite and arsenopyrite in vugs and cavities. No trend was observed but adit appears to follow a NW. heading. Some minor amounts of malachite stain are associated with quartz-filled shear zones.	Two adits, 140 ft and 60 ft long, and a caved adit estimated to be about 200 ft long.	Five chip samples and one select sample of quartz: the chip samples contained less than 4.2 ppm silver and one sample contained 0.32% copper. The select sample contained 0.146 oz/ton gold, 5.8 oz/ton silver and 0.22% copper.
35	Monte Cristo Mine	See text.		
36	Prospect	Vuggy, iron-oxide-stained quartz hosted by muscovite schist.	Two caved adits totaling an estimated 400-500 ft long, one shallow pit.	One grab sample: 0.076 oz/ton gold and 0.3 oz/ton silver.
37	Quartz vein outcrop	Precambrian muscovite schist contains a lightly hematite-stained quartz pod about 2.5 ft by 8 ft; with a few remnant sulfide boxwork structures and no visible sulfide minerals.	None	One chip sample: no gold or silver detected, 30 ppm copper, 60 ppm lead, 97 ppm zinc.
38	Prospect	Quartz vein in muscovite schist.	One caved adit, estimated at <30 ft long, two shallow pits.	Two grab samples: one contained a trace gold, no silver detected; no gold or silver detected in the second sample.
39	Prospect	Quartz vein containing a trace of pyrite and malachite hosted by biotite schist.	One shallow pit.	One grab sample: no gold or silver detected.
40	Prospect	Metasedimentary rock intruded by intermediate dike.	One shallow pit.	One grab sample of metasediments: trace gold, no silver detected.
41	Prospect	Bull quartz vein in white quartzite.	One shallow pit.	One grab sample: trace gold, no silver detected, 105 ppm copper.
42	Prospect	Iron-oxide-stained quartz vein with some malachite hosted by muscovite schist.	Three caved adits, totaling about 150 - 200 ft long, two shallow pits.	Three grab samples: one contained 0.062 oz/ton gold; no silver detected.

Table 2.--Mines, prospects, claims, and mineralized areas in the Loon Creek-Warm Spring Creek Unit--Continued

Map no.	Name	Geology	Workings and production	Sample and resource data
43	Prospect	Quartz-filled fissures are in quartz monzonite. Quartz is stained by iron oxide.	Two small sloughed pits.	Two grab samples: one sample contained 0.008 oz/ton gold.
44	Prospect *	Fractured, weathered and weakly-foliated quartz monzonite has fine-grained pyrite and chalcopyrite along joints and fractures as well as disseminated in the rock.	None	One chip sample: 90 ppm copper. Yinger (1976, p. 102) shows nineteen samples ranging from 40 to 170 ppm copper and averaging 63 ppm.
45	Prospect *	Hematite-stained shear zone in altered metasedimentary rock overlain by terrace gravels.	One partially caved adit, estimated at <20 ft long.	One chip sample: no gold or silver detected.
46	Prospect	Lightly to moderately iron-oxide-stained quartz vein in chlorite-muscovite schist.	Four shallow pits.	Four samples: no gold or silver detected in three grab samples and one chip sample.
47	Prospect	Silicified shear zone in muscovite-chlorite schist is near contact with rhyolite dike.	One caved adit.	One chip sample: no gold or silver detected.
48	Prospect	Quartz veins are in muscovite schist intruded by dacite and granophyre dikes.	Two caved adits, estimated to total <100 ft long, four shallow pits.	Three samples: no gold detected in two grab samples and a chip sample; one grab sample contained 0.4 oz/ton silver.
49	Prospect*	Lightly iron-oxide-stained quartz veinlets cut dacite porphyry.	One bulldozer trench, one shallow pit.	One grab sample: no gold or silver detected.
50	Prospect	Quartz-feldspar pegmatite dike cuts weakly-foliated quartz monzonite.	Shallow pit.	One grab sample: no gold or silver detected.
51	Prospect	Weakly-foliated quartz monzonite is intruded by dacite porphyry dike. A three inch thick quartz vein (N. 80° E, 45° SE.) separates the two rock types near the portal of the main adit. Both structures contain some pyrite and malachite.	One 80-ft adit, one 20-ft adit, one shallow surface pit which could be a short, caved adit.	Eight samples of quartz vein: seven chip samples contained trace to 0.05 oz/ton gold, a trace to 0.01 oz/ton silver, and 5.5% to 26.8% copper; one grab sample contained 0.83 oz/ton gold, 0.21 oz/ton silver, and 0.2% copper.
52	Prospect	Hematite-stained shear zone in altered metasedimentary rock.	One caved adit, estimated at <15 ft long.	One chip sample: no gold or silver detected.
53	Prospect *	Hematite-stained quartz vein and veinlets cut weakly-foliated quartz monzonite. Structures could not be traced beyond immediate vicinity of the workings.	Two shallow pits.	One grab sample: 0.176 oz/ton gold and 0.7 oz/ton silver.

Table 2.--Mines, prospects, claims, and mineralized areas in the Loon Creek-Warm Spring Creek Unit--Continued

Map no.	Name	Geology	Workings and production	Sample and resource data
54	Prospect	Hematite- and manganese-stained quartz vein is in weakly-foliated quartz monzonite intruded by andesite dike.	One caved adit, estimated at <50 ft long.	One grab sample: no gold or silver detected.
55	Prospect	Coarse-grained, weakly-foliated quartz monzonite intruded by diorite dike. Quartz-monzonite-hosted quartz vein in adit is 3 ft thick and trends north and dips 70° W.	Two adits totaling <50 ft long, one caved adit estimated at >100 ft long, three shallow pits.	Three samples: one grab sample contained 0.3 oz/ton silver; no gold or silver detected in the others.
56	Prospect	A quartz vein 1.4 ft thick is hosted by weakly-foliated quartz monzonite. The vein trends N. 5° W, dips 80° SW and has light to moderate iron oxide stains.	Three caved adits, totaling an estimated 200 ft long, two shallow pits.	One chip sample, one grab sample: no gold or silver detected.
57	Prospect	Moderately hematite-stained quartz vein with trace of fine-grained pyrite boxwork hosted by weakly-foliated quartz monzonite intruded by dacite and andesite dikes. The quartz vein is 2 ft thick, trends N. 60° E, and dips 85° SE.	Two caved adits, one estimated at <100 ft long, nine shallow pits.	Six grab samples: no gold or silver detected.
58	Prospect *	Weakly foliated and propylitized quartz monzonite country rock hosts a quartz-muscovite fissure vein trending N-S. The country rock has been intruded by diorite, dacite, andesite, rhyolite porphyry, aplite, and granophyre dikes. Quartz vein approximately 2.5 ft thick contains limonite pseudomophs after pyrite but no visible sulfides.	Two caved adits, estimated at 200 ft total length, possible sloughed short adit, two shallow pits.	Two grab samples: one contained 0.03 oz/ton gold and 0.5 oz/ton silver; the other contained 0.2 oz/ton silver but no gold was detected.
59	Prospect	Quartz veins are in gneiss and biotite schist.	Four shallow pits.	One grab and one chip sample: each had 0.2 oz/ton silver; no gold detected.
60	Effa Claim	Lower adit is driven along contact between granophyre dike and silicified schist. A shear zone contains quartz pods and lenses with as much as 15% sulfide minerals, dominantly pyrite with some chalcopyrite and arsenopyrite. Upper adit is driven in dacite porphyry apparently to intersect sulfide-bearing zones exposed in shallow pits above.	Two adits totaling more than 200 ft long, several small pits.	Three chip samples in lower adit: two contained 0.062 and 0.226 oz/ton gold, 0.6 and 4.8 oz/ton silver, and 0.01% to 0.04% copper. Four samples at upper workings contained no gold or silver, two grab samples and one chip sample contained from 0.05% to 0.46% copper, one grab sample contained 0.188 oz/ton gold and 1.8 oz/ton silver.
61	Lost Packer Mine *	See text.		

Table 2.--Mines, prospects, claims, and mineralized areas in the Loon Creek-Warm Spring Creek Unit--Continued

Map no.	Name	Geology	Workings and production	Sample and resource data
62	Prospect	Quartz fissure vein in schist.	One caved adit, estimated at 400 ft long.	One grab sample: no gold or silver detected.
63	Prospect	Quartz fissure vein in schist; as much as 10% pyrite is in some quartz fragments.	One caved adit, estimated at <100 ft long.	One grab sample: no gold detected, 0.2 oz/ton silver.
64	Prospect	Silicified to dolomitic limestone is near contact with intermediate dike.	Two caved adits, one estimated at <100 ft and two shallow pits. This property may have produced flux for the smelter at the Lost Packer Mine (Ross 1934, p. 123-124).	Two grab samples: no gold or silver detected.
65	Prospect	Disseminated, fine-grained pyrite, mostly altered to limonite, is in quartzite.	Three shallow pits. This property may have produced a limited amount of flux for the smelter at the Lost Packer Mine (Ross, 1934, p. 123-124).	Two grab samples: one contained 0.006 oz/ton gold; no silver detected.
66	Prospect	Dark-gray, silicified limestone has been intruded by diorite.	One caved adit, estimated at >100 ft long. This property probably provided flux to the Lost Packer smelter (Ross, 1934, p. 123-124).	Two grab samples of limestone: trace and 0.026 oz/ton gold, one had 0.5 oz/ton silver; one sample had 0.099% copper, 0.027% lead, and and 0.056% zinc.
67	Blue Bird Claim	Contact between silicified schist (base of a pendant?) and diorite intrusive.	One 140-ft long adit, three shallow surface pits.	Six chip samples: no gold or silver detected; minor amounts of arsenic, cobalt, fluorite, molybdenum, tungsten, copper, and zinc are present.
68	Sunrise (Metcalf) Claim	Quartz monzonite-dolomitic limestone contact zone strikes N. 8 E. and dips 75° NW.	Three adits totaling 100 ft, one shallow shaft and 12 pits.	Seven chip samples: no gold or silver detected.

Table 2.--Mines, prospects, claims, and mineralized areas in the Loon Creek-Warm Spring Creek Unit--Continued

Map no.	Name	Geology	Workings and production	Sample and resource data
69	Lost Eagle Claim	Precambrian quartz-biotite schist displays local sericitic alteration. Fissure vein, with associated shear zones contains quartz, siderite with minor pyrite, chalcopyrite and galena. The fissure vein strikes N. 5° W. and dips 85° SW and the zone is 6 to 15 ft thick.	Six pits, a collapsed adit of unknown length, a shaft reported to be 50 ft deep (Umpleby 1913) and several bulldozer cuts.	Eight chip samples: no gold detected; two samples contained 5.6 and 0.2 oz/ton silver.
70	Prospect	Quartz fissure vein in silicified schist intruded by dacite porphyry.	One caved adit, estimated <50 ft long, one 5-ft adit, three shallow pits.	Two grab samples: 0.2 oz/ton silver, no gold detected.
71	Prospect	Heavily iron-oxide-stained fracture zones. A 1- to 2-ft-thick fracture zone strikes N. 50° W. and dips 75° SW in diorite and silicified schist. The zones are cut by aplite dikes and dikelets and can be traced intermittently along the surface for about 130 ft. Vein material consists of massive chalcopyrite as shoots in a quartz matrix with sulfide-boxwork.	Three adits totaling approximately 400 ft long; one caved adit, estimated at <25 ft long; one water-filled shaft, estimated at <20 ft deep; one small pit.	Seven chip samples and two grab samples: gold ranged to 0.21 oz/ton, silver ranged to 1.5 oz/ton, copper (in seven samples) ranged to 10.3%, and one sample contained 0.29% lead and 0.27% zinc.
72	Prospect	Pyrite and chalcopyrite fill fractures along contact between aplite dike and diorite.	One 12-ft adit.	One chip sample: no gold or silver detected, 0.01% copper.
73	Prospect	Quartz-hematite veins fill fractures in dark gray siliceous limestone.	Two shallow pits.	Two chip samples, one grab sample: 1 oz/ton silver; grab sample contained <0.2 oz/ton silver, no gold detected.
74	Whiskey Group Claims	Quartz fills fractures that strike NW 30° and dip 40° SW in siliceous, argillaceous limestone.	One 27-ft adit, one bulldozer trench, three shallow pits.	Five samples: three chip samples contained <0.005, 0.028, and 0.03 oz/ton gold and <0.2, 1.9, and 2.5 oz/ton silver; two grab samples contained 0.046 and 0.026 oz/ton gold, and 12.9 and 10.7 oz/ton silver.
75	Prospect	Quartz fissure vein cuts quartz monzonite.	Two caved adits, estimated at <50 ft total length.	One grab sample: 0.01 oz/ton gold, 1.3 oz/ton silver, 0.38% lead, 0.39% zinc.
76	Prospect	Quartz vein material contains pyrite, sphalerite and galena, some calcite, and sulfide boxwork; vein is presumably hosted by dacite porphyry.	One caved adit, estimated at <50 ft long, three shallow pits, one caved shaft, and one sloughed trench.	Three grab samples: trace gold, 0.4 to 5.3 oz/ton silver, 0.73 to 2.51% lead, and 0.83 to 10.4% zinc.

Table 2.--Mines, prospects, claims, and mineralized areas in the Loon Creek-Warm Spring Creek Unit--Continued

Map no.	Name	Geology	Workings and production	Sample and resource data
77	Prospect	Quartz vein, about 2 ft thick, trends N. 28° W., dips 49° NE., and cuts siliceous to dolomitic limestone. The quartz is lightly iron-oxide-stained.	One 30-ft-long adit, one caved adit estimated at < 15 ft long.	Three samples: one chip sample contained 0.014 oz/ton gold and 0.2 oz/ton silver; two grab samples, one contained 0.168 oz/ton gold and 1.5 oz/ton silver; no gold or silver detected in a second grab sample.
78	Prospect*	Quartz fissure vein in rhyolite dike in granodiorite.	One caved adit, estimated at <50 ft long.	One grab sample: no gold or silver detected.
79	Mahan Claim *	Silicified limestone, intruded by mafic dike, surrounded by granodiorite.	Two shallow pits.	Three samples: no gold or silver detected; one grab sample of limestone had 0.04% copper.
80	16-to-1 Claims *	Small pendants of limestone hosted by granodiorite.	One caved adit estimated at <50 ft long, several bulldozer trenches and small pits.	Four samples: no gold detected; two samples contained 0.3 and 0.5 oz/ton silver, three contained 0.02, 0.18, and 0.80% lead and 3.2, 0.04 and 0.11% zinc.
81	16-to-1 Patented * Claims	Limestone pendant in granodiorite.	One 10-ft-long adit, one caved adit estimated at 150-250 ft long; five dulldozer trenches, one shallow pit.	Five samples: no gold detected; two contained 0.3 oz/ton silver, three contained from 0.02 to 0.41% lead, and 0.01 to 1.4% zinc.
82	Lovenest Claim *	Northwest-trending, 5- to 20-ft-thick shear zone in quartz monzonite with mafic dikes and metasedimentary xenoliths.	One 20-ft-long adit, one 50-ft-long trench and seven pits.	Twelve samples (nine chip, three select): one select contained 2.6 oz/ton silver, 0.34% lead and 0.51% zinc; no gold detected. Three chip samples contained an average of 0.06% zinc, no gold or silver was detected.
83	Prospect *	Metasedimentary xenolith in quartz monzonite.	One 5-ft-long adit.	One grab sample: no gold or silver detected.
84	Nessie No. 12 Claim	Northwest-striking sulfide zone in quartz monzonite cut by mafic dikes. Zone is greater than 160 ft long and 12 ft thick, and is exposed vertically for 50 ft. Pyrite, galena, and sphalerite are disseminated throughout.	Two adits, 160 ft and 25 ft long.	Twelve samples: two select samples contained 0.160 and 0.328 oz/ton gold, 2.8 and 50.0 oz/ton silver, 0.1% and 0.2% copper, 2.39% and 8.30% lead, and 0.03% and 2.40% zinc. Of ten chip samples, four averaged 0.325 oz/ton silver; nine samples analyzed for copper contained no more than 0.01% copper. Lead and zinc content for the nine samples was 0.13% and 0.06%, respectively.

Table 2.--Mines, prospects, claims, and mineralized areas in the Loon Creek-Warm Spring Creek Unit--Continued

Map no.	Name	Geology	Workings and production	Sample and resource data
85	Betty Ruth Claim*	See text.		
86	Wild Buck Claim *	See text.		
87	Surprise No. 1 * Claim	Shear zone with pyrite cuts granodiorite.	One 20-ft-long adit.	One sample: 0.02% zinc; no gold or silver detected.
88	Canary Yellow * Claim	See text.		
89	Bonanza No. 1 * Claim	Four-in.-thick pyrite-bearing quartz vein strikes N. 42° W. in granodiorite.	Two trenches and three small pits.	Two samples: grab sample contained 0.048 oz/ton gold, 0.7 oz/ton silver, 0.08% lead, and 0.1% zinc; chip sample contained 0.005 oz/ton gold and 0.2 oz/ton silver.
90	Long Shot * Nos. 1-3 Claims	See text.		
91	Prospect	Quartz monzonite crosscut by aplite dikes.	One shaft, two open cuts, and two bulldozer cuts.	Two chip samples of monzonite: no gold or silver detected.
92	Winn B Claim	Fine- to medium-grained quartz monzonite.	One small open cut.	One chip sample: no gold or silver detected.
93	Williamson (Phonta-Williamson) Claim	Limonite-stained silicified metasedimentary rock xenoliths in quartz monzonite. The xenoliths are phyllitic to schistose and some have shear zones as well as quartz veins. The xenoliths range in size from a few feet to several hundred feet long; most have disseminated pyrite and some have disseminated arsenopyrite. Two of the largest blocks contain shear zones mineralized by sulfide-bearing siliceous hydrothermal solutions. These shear zones are 4 to 5 ft thick, generally parallel the foliation of the metasediments, and contain pyrite, arsenopyrite, sphalerite, galena, gold, and unidentified silver-bearing mineral.	Five pits and three adits 130 ft, 96 ft, and 12 ft long. No known production but several tons of ore are stockpiled at the portal of one adit.	Fourteen samples of shear zones and metasediments: 0.26 and 0.006 oz/ton gold in two of twelve chip samples and 1.0, 1.1, 1.4, 1.4, 1.8, 3.0, and 5.4 oz/ton silver in seven chip samples; eleven chip samples averaged 0.33% lead and 0.15% zinc. Two grab samples contain 8.0 and 86.2 oz/ton silver, and one grab sample contained 0.058 oz/ton gold; the two samples contained 0.37 and 1.44% lead and one contained 0.92% zinc.
94	Stella (Iron Blossom) Claim	Iron-oxide-stained zones quartz monzonite. Locally disseminated pyrite and dump material at a pit indicates a shear zone that has extensive chloritic alteration.	Two sloughed shallow pits.	Two chip samples and three grab samples: no gold or silver detected.
95	Prospect	Quartz veins in a minor shear zone in quartz monzonite.	One adit about 15 ft long; portal is partially collapsed.	One chip and one grab sample: no gold or silver detected.

Table 2.--Mines, prospects, claims, and mineralized areas in the Loon Creek-Warm Spring Creek Unit--Continued

Map no.	Name	Geology	Workings and production	Sample and resource data
96	Pinyon Silver Nos. 1-3 Claims	Xenoliths of argillite to schist containing disseminated pyrite and arsenopyrite occur in quartz monzonite. Xenoliths have been fractured and sheared and contain up to 5% quartz.	Three adits and five pits. All adits less than 30 ft long.	Ten chip samples: two samples had 0.01 and 0.018 oz/ton gold and three samples contained 3.4, 2.6, and 0.6 oz/ton silver. Less than 0.06% lead was detected and only one sample contained more than 0.08% zinc (0.44% zinc).
97	Last Dollar Claim	Metasedimentary rock xenolith in quartz monzonite contains disseminated pyrite and numerous quartz-filled fracture zones.	Two adits: 50 ft and 20 ft long.	One chip sample: 0.05% and 0.07% lead and zinc, respectively.
98	Prospect	Metasedimentary rock xenoliths in quartz monzonite are pyritized and have numerous quartz-filled fractures.	Two small pits.	Two chip samples: no gold or silver detected.
99	Kidney Lake Prospect	Hematite-stained, siliceous metasedimentary rock, probably schist, has less than 5% disseminated pyrite and pyrrhotite.	One bulldozer trench, one shallow pit.	Two grab samples: no gold or silver detected.
100	Prospect *	Hematite-stained shear zone in silicified schist.	One shallow pit.	One chip sample: no gold or silver detected.
101	Prospect *	Iron-oxide-stained xenolith of metasedimentary rock contains disseminated pyrite. The xenolith is enclosed by quartz monzonite.	One shallow pit.	One chip sample: no gold or silver detected.
102	Francisco Claim *	Xenoliths of metasedimentary rock in quartz monzonite are pyritized and have minor quartz veins.	Two small pits.	One chip sample: no gold or silver detected.
103	Prospect *	Pyrite and arsenopyrite occur in metasedimentary xenoliths in quartz monzonite	One open cut.	One chip sample: no gold or silver detected.
104	PW 83 and 84 * Claims	Iron-oxide-stained, silicified metasedimentary rock xenoliths in quartz monzonite.	Five small pits.	Five chip samples and one grab sample: one chip sample had 0.3 oz/ton silver.
105	Prospect *	Silicified, hematite-stained schist.	One shallow pit.	One chip sample: no gold or silver detected.
106	Prospect *	Quartz and fibrous calcite fill fractures in hematite-stained quartz monzonite.	One shallow pit.	One grab sample: no gold or silver detected.
107	Do J No. 1 * Claim	Metasedimentary rock xenoliths in quartz monzonite contain four iron-oxide-stained shear zones that have been silicified and contain disseminated pyrite.	Two adits, 20 ft long and 8 ft long; two open cuts, 30 x 5 ft and 12 x 6 ft.	Five chip samples: one sample contained 0.036 oz/ton gold and another contained 0.2 troy oz/ton silver.

MINERAL APPRAISAL OF THE SPECIAL MINING MANAGEMENT ZONE--CLEAR CREEK, LEMHI COUNTY, IDAHO

by

Leon E. Esparza, Michael S. Miller,
and Paul A. Pierce

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Table 3. Lode production from mining districts near the Special Mining Management Zone--Clear Creek 83

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INTRODUCTION

This chapter consists of material submitted to the U.S. Geological Survey in November 1982 for a jointly-published report on the Special Mining Management Zone--Clear Creek (Lund and others, 1983c). The data have been updated to include research published subsequent to November 1982.

Location and Access

The Special Mining Management Zone--Clear Creek (SMMZ) is located 8 miles southwest of Shoup, Idaho, in the Salmon River Mountains and encompasses an area of about 39,000 acres. It is bounded on the north by the Salmon River, the east by Panther Creek, and the south by Gant Ridge; the sinuous west boundary begins at the confluence of the Middle Fork and main Salmon Rivers, passes across Dome Mountain, and terminates at Gant Ridge (fig. 13).

The study area can be reached by following Forest Service Road 030 west from North Fork, Idaho; this road parallels the northern boundary of the study area west of Panther Creek. The eastern part can be reached by Forest Road 055, an all weather road from Salmon, Idaho.

Setting

The study area is characterized by steep, rugged, locally precipitous terrain, with deeply incised drainages. Elevations range from 9,316 ft at Dome Mountain to 3,200 ft on the Salmon River near its confluence with Panther Creek. Major streams flow principally to the northeast and include Clear Creek and Garden Creek. Vegetation consists of Douglas fir, subalpine fir, Engelman spruce, lodgepole pine, mountain mahogany, nine-bark, pine grass, and grouse whortle berry.

Portions of the Blackbird and Mackinaw (Leesburg) mining districts are included within the study area; the Mineral Hill mining district abuts the study area along its northern border (fig. 3).

Previous Investigations

Geologic research in the study area and vicinity includes reports by Maley (1974), Cater and others (1975), Knowles (1975), Bennett (1977), Hughes (1983), and Modreski (1983). Additional references include geochemical investigations by Broxton and Beyth (1980), and geophysical data by EG & G Geometrics (1980). A uranium resource evaluation of the Elk City 2° quadrangle has been done by Leinart and Salisbury (1981). Reports on the cobalt deposits of the Blackbird district have been written by Anderson (1943b, 1947a), Reed and Herdlick (1947), Vhay (1948), Hawkes (1952), Canney and others (1953), Roberts (1953), Shenon and others (1955), Cole (1956), Romischer and Maclaren (1959), and Purdue (1975). The Salmon Canyon Copper Mine has been described by E.T. Tuchek (Weis and others, 1971).

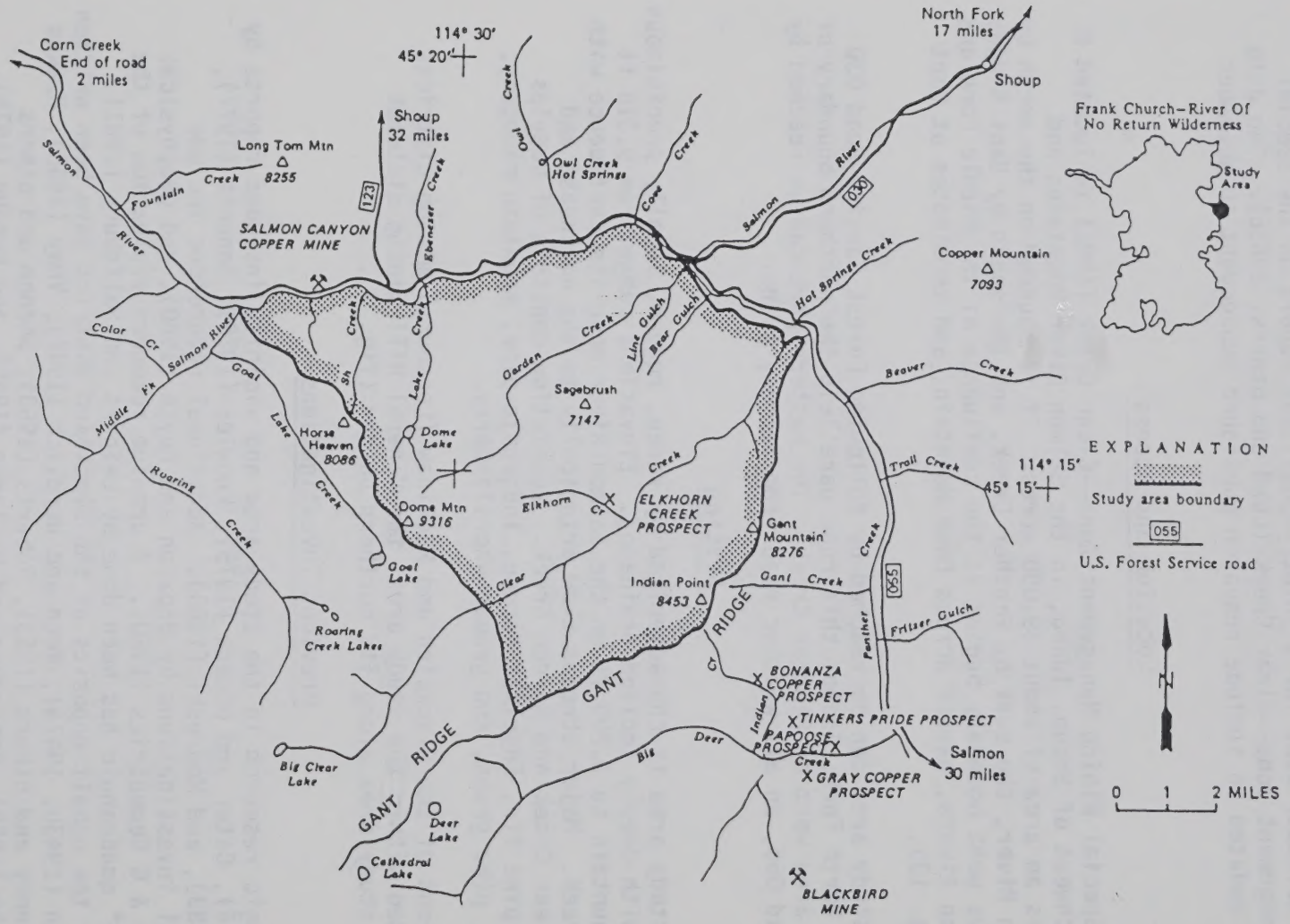

FIGURE 13.–The Special Mining Management Zone–Clear Creek, Lemhi County, Idaho

MINERAL APPRAISAL

Mining History

Although there is no history of mining activity within the unit, production records indicate mining activity from the Mineral Hill, Mackinaw, and Blackbird districts. Production from these mining districts is summarized in table 3. Nearly all production from the Blackbird district is from the vicinity of the Blackbird Mine. Gold, silver, copper, and lead were mined mainly from the late 1800's to the 1940's; cobalt was mined mainly in the early 1900's and in the 1950's. Mining activity in the Mackinaw and Mineral Hill districts is currently being encouraged by relatively high gold and silver prices. However, low copper and cobalt prices have discouraged mining, especially in the Blackbird district.

TABLE 3.--Lode production from mining districts near the Special Mining Management Zone--Clear Creek

[U.S. Bureau of Mines records]

Mining District	Gold (troy oz x 1000)	Silver (troy oz x 1000)	Copper (lb x 1000)	Lead (lb x 1000)	Cobalt (lb x 1000)
Blackbird	35	80	64,000	1	14,000 1/
Mackinaw	2	6	74	114	N 2/
Mineral Hill	23	15	13	99	N

1/ Prior to 1940's, production of Blackbird district was 21.5 tons of cobalt from 618 tons of ore (Reed and Herdlick, 1947, p. 4).
2/ None reported.

Geologic Setting

According to Lund and others (1983c, p. 4), two Precambrian Y formations consisting predominantly of clastic metasedimentary rocks underlie the study area. The formations are intruded by felsic plutons of Precambrian Y, Cretaceous, and Tertiary ages. Alluvium and morainal deposits locally cover these rocks. Thrust faults and numerous, steeply dipping normal faults cut the granitic and metasedimentary rocks.

Cobalt, the commodity of primary interest regionally, occurs with copper outside the study area in the Blackbird mining district to the south and at the Salmon Canyon Copper Mine to the northwest. The salient characteristics of these occurrences are given in table 4.

Table 4.--Salient features of cobalt-copper deposits near the Special Mining

Name	Lithology	Attitude	Structures	Mineralization
Blackbird mining district: Blackbird Mine	Thinly laminated and bedded, micaceous quartzite; schist	Northeast to east strike, 45° N.-NE. dip, 34°-45° N. plunge.	Northwest trending normal faults with low to moderate northeast dips, north-trending normal and reverse faults with steep dips; north and northwest shears.	Sulfides: cobaltite, chalcopyrite, pyrrhotite and pyrite. Gangue: quartz, biotite, tourmaline, hornblende, chlorite, muscovite, ankerite, siderite, calcite, and apatite.
Big Deer Creek deposits (Bonanza Copper, Tinkers Pride, and Gray Copper)	Thickly-bedded quartz, biotite schist and phyllite, some garnet schist.	Generally east to west-northwest strike, gentle north and east dips.	Northeast to northwest-trending (White Ledge shear zone).	Sulfides: cobaltite, chalcopyrite with some pyrite and pyrrhotite. Gangue: Quartz, tourmaline, biotite, chlorite, hornblende.
Salmon Canyon Copper Mine	Quartz-biotite schist, quartz-biotite-garnet schist.	Northeast strike, 25° NW. dip.	Weak zones of foliation associated with predominantly northeast-trending faults.	Sulfides: pyrite, chalcopyrite, arsenopyrite, chalcocite. Gangue: quartz, biotite.

Management Zone--Clear Creek

Geometry of ore body or occurrence	Type of occurrence	Depositional controls	References
Tabular and podiform.	Disseminations, veinlets, and stringers.	Shears; lithology, folds are secondary controls.	Anderson (1947a), Vhay, (1948), Cole (1956), Shenon and others (1955), Purdue (1975)
Tabular?	Blebs, stringers, disseminations. controls--folds, lithology, high-angle faults.	Primary control-- shears; secondary and MacLaren (1959)	Shenon and others (1955), Bennett (1977), Romischer
Tabular?	Disseminations, streaks, bands.	Lithology.	Weis and others (1971)

Surficial indications of these occurrences include the presence of erythrite, a hydrous cobalt arsenate, and copper carbonate minerals. Tourmaline and quartz are commonly associated with cobalt-copper ore in the region (Shenon and others, 1955, p. 15), and deposits are believed to be most common near the contact between the Yellowjacket Formation and augen gneiss (Bennett, 1977, p. 48). Tourmaline was noted in quartz in the Blackbird district (Bennett, 1977, p. 45) and in micaceous quartzite east of Panther Creek (Maley, 1974, p. 19).

Geochemical data indicate that stream sediments, in areas of known cobalt deposits, contain arsenic-to-cobalt ratios of 3 to 1 or greater (Broxton and Beyth, 1980). Boron, an elemental constituent of tourmaline, may also indicate cobalt occurrences.

Mines, Prospects, and Mineralized Areas

Cobalt-Copper Prospects

A total of 39 samples were collected from lodes in and adjacent to the Special Mining Management Zone (SMMZ); most were collected from copper-cobalt occurrences.

On Elkhorn Creek, near its confluence with Clear Creek, is an occurrence of cobalt and copper similar in its surficial characteristics to the deposits summarized in table 4. Most rocks at this site are gray to white, banded biotite schist, quartzite, and gneiss in layers ranging from 1 to 10 ft thick. Intense folding and shearing have developed a false bedding (Bennett, 1977, p. 12; Maley, 1974, p. 11). East of Elkhorn Creek, these rocks trend northwest and dip northeast. Erythrite, azurite, and malachite sporadically stain outcrops, especially where fractured. Only a few small pits were at Elkhorn and Deadhorse Creeks and were probably dug prior to the 1940's (Paul Kriley, verbal communication, 1982). Noranda Exploration, Inc. holds claims on the Elkhorn Creek occurrence and adjacent land. Plans for exploratory drilling by Noranda were postponed indefinitely in 1982.

Samples of mineralized rock collected from this occurrence contained as much as 0.16% cobalt and 0.175% copper. These samples were essentially surficial as deeper, unoxidized material could not be obtained. The samples are from three outcrops which represent a northwest-trending zone that appears to encompass an area approximately one-half mile long by one-quarter mile wide. Electronmicroprobe analysis of one sample revealed the presence of less than 1% cobaltite which occurs as fine, scattered grains. Black tourmaline (shorl) comprises about 4% of the specimen.

Although it is known that the Blackbird cobalt deposit is truncated about 1 mile southeast of Indian Point, probably by faulting (Shenon and others, 1955), and thus does not surficially extend into the study area, the following lines of evidence suggest similar deposits of this type at depth.

1. The psuedo-contour map of residual intensity magnetic data for the Elk City quadrangle (U.S. Department of Energy, 1982b) shows a lineament of 40 gammas trending northwest into the SMMZ. The lineament passes just northeast of the Blackbird Mine and is closed on its northwest end by the 200 gamma contour. These data are interpreted to indicate that similar lithologies exist in the study area, the Blackbird district, and at the Salmon Canyon Copper Mine.

2. Potassium, uranium, and thorium total-count airborne radiometric maps (EG & G geoMetrics, 1980) offer additional evidence for continuity of favorable host rocks into the study area; they indicate a weak northwest trend similar to the magnetic anomaly.

3. Boron in stream sediment samples provides evidence for the presence of the cobalt-bearing zone in the SMMZ. Data presented by Cater and others (1975) show a low-level boron anomaly trending northwesterly into the area, generally along the trend of the aeromagnetic and airborne radiometric lineaments discussed above. In addition, Broxton and Beyth (1980) show a low-relief, north-trending arsenic anomaly from the Blackbird mining district to the Salmon Canyon Copper mine.

4. Mineralized sites and lithology similar to the Salmon Canyon Copper Mine are reported to extend southeastward into the study area (James Schulte, verbal communication, 1982).

Other Commodities

Geochemical data of Cater and others (1975) and Broxton and Beyth (1980) indicate anomalous gold, silver, copper, lead, zinc, uranium, and thorium in the northeast part of the study area, coincident with an aeromagnetic high shown by the U. S. Department of Energy (1982b). Base and precious metals in this area may be similar to occurrences elsewhere in the Mackinaw mining district, such as the Ringbone Cayuse and Blue Jay mines, where deposits resulted from intrusion of the Leesburg stock (Bennett, 1977, p. 49).

ASSESSMENT OF MINERAL RESOURCES

Rock units similar to those hosting copper-cobalt deposits at the Blackbird Mine occur within the study area. These units are reported by Lund and others (1983c) to have a high to moderate potential for copper-cobalt deposits. The author agrees with these conclusions based on field observations, samples taken at the Elkhorn Creek Prospect, and analysis of geochemical and geophysical data published by Broxton and Beyth (1980), EG&G Geometrics (1980), and the U.S. Department of Energy (1982b).

Lund and others (1983c) show no potential for copper-silver, lead-zinc and precious metals based on, among other things, an absence of appropriate geochemical anomalies. Geochemical data published by Cater and others (1975), Bennett (1977), Broxton and Beyth (1980), and geophysical data published by the U.S. Department of Energy (1982b) appear to contradict this assessment. Precious- and base-metal anomalies are indicated in the northeastern portion of the study area. Additional inspection of all the data is warranted.

MINERAL APPRAISAL OF THE PINNACLES-RAINBOW PEAK UNIT, VALLEY COUNTY, IDAHO

by

David A. Benjamin and Douglas I. Jayne

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INTRODUCTION

Location and Access

The Pinnacles-Rainbow Peak unit covers approximately 32,400 acres north of the East Fork of the South Fork (EFSF) of the Salmon River in the Payette National Forest in north central Valley County, Idaho (fig. 14). The Pinnacles, larger of the two study areas, contains approximately 28,500 acres while the Rainbow Peak area contains approximately 3,900 acres. Yellow Pine, located approximately 6 miles west of the southwestern corner of the Pinnacles study area, is the nearest population center. The unit is most directly accessible via Forest Service Road 48 over 6,920-ft Lick Creek Summit from McCall to Yellow Pine, a distance of 54 miles. In winter, all the roads leading to the study areas are closed due to snow. Yellow Pine and Big Creek are also accessible by light aircraft. Both study areas are bounded on the east by the former Idaho Primitive Area.

Setting

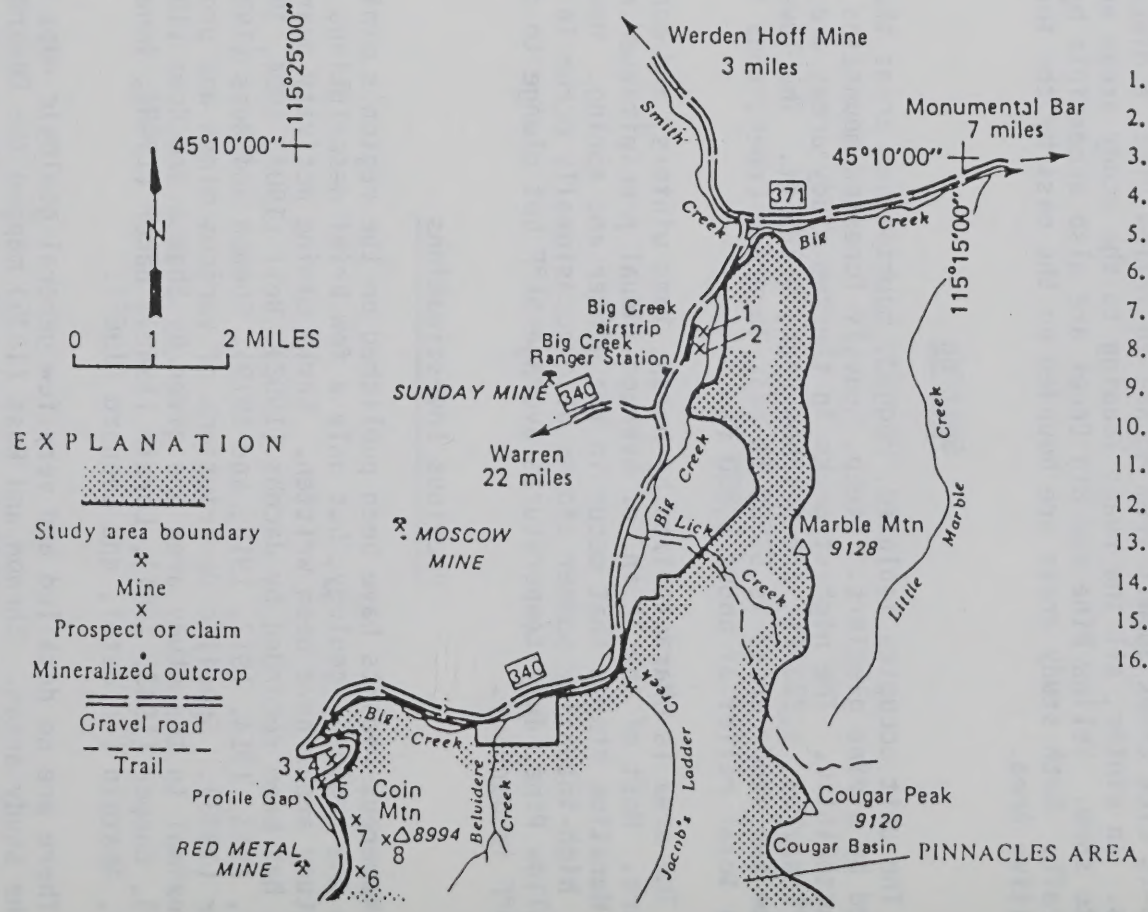
The unit occupies isolated, rugged, mountainous areas that have been eroded by alpine glaciers. Steep, heavily forested mountains are characteristic. The highest peaks in the two study areas are, respectively, the Pinnacles, 9,273 ft, and Rainbow Peak, 9,325 ft. The lowest elevation of the two study areas is 5,500 ft near Tamarack Creek; thus the region has a total relief of about 3,800 ft.

The area is characterized by harsh, long winters, and cool, dry summers. Most of the 32 in. of average annual precipitation results from long duration storms that occur in the winter and spring. However, short term, high-intensity summer storms also occasionally occur in the area. In Yellow Pine, July temperatures average 61°F but plunge to an average of 19°F in January.

Previous Investigations

Numerous reports have been published on the region's mining districts, or on the regional geology, but only a few brief descriptions specific to the study areas have been written. Early mining activity near the study areas has been recorded by Jacobs (1902), Bell (1903, 1904, 1911, 1912a, 1912b, 1913, 1914, 1917, 1918, and 1919), Shenon and Ross (1936), and Cooper (1943). Specific descriptions of various mines and prospects in or proximal to the study area are given by Shenon and Ross (1936), Slovarp (1942), Cooper (1943, 1951), Lorain (1942), Baker (1948), Innes (no date), Abstein (no date), and Leonard (1965).

There are no detailed and very few general geologic maps published for the study areas. Shenon and Ross (1936) mapped the Edwardsburg-Thunder Mountain region. White (1940b) added detail along the southern portion of the Pinnacles study area. Kiilsgaard (1947) prepared a compilation of the Valley County geology. The geology east of and adjacent to the Pinnacles-Rainbow Peak unit was mapped by Cater and others (1973).



Mines, Prospects, and Claims

1. Freddie Claim
2. Blue Bird, Blue Ribbon Prospect
3. Profile Gap Prospect (Syringa)
4. B and B Prospect
5. Palmetto Claim
6. Lotspiech Mine
7. Prospects north of Lotspiech Mine
8. Prospect
9. Central Galena group (patented)
10. Prospects west of the Pinnacles
11. Copper Cliff Group
12. Prospect
13. Rainbow Peak Prospect
14. Outcrop south of Rainbow Peak
15. Prospect
16. Prospect

FIGURE 14.–The Pinnacles-Rainbow Peak unit, Valley County, Idaho

MINERAL APPRAISAL

Mining History

The Pinnacles-Rainbow Peak unit encompasses portions of the Yellow Pine, Profile, and Edwardsburg (Big Creek) mining districts; the Thunder Mountain mining district abuts the Rainbow Peak area on the east (fig. 3). The earliest recorded mining activity in the vicinity of the study areas took place in 1898 when the Independence Group Claims were located in the northern Edwardsburg (Big Creek) mining district (Umpleby and Livingston, 1920, p. 10). Most of the mining claims in the Profile Gap and Big Creek areas were located and worked during the Thunder Mountain boom period from 1896 until 1910.

After 1910, mining activity subsided until the early 1930's when increased gold prices renewed interest in mining. Most of the development work on the Central Galena (fig. 18, no. 9) and Copper Cliff (fig. 18, no. 11) properties was done at this time (Baker, 1948, p. 2, Cooper, 1943, p. 1). During the 1940's, the area near Profile Gap was investigated for antimony and tungsten as part of U.S. Bureau of Mines Strategic Minerals Investigation Program (Lorain, 1942). Very little activity has taken place until recently except for the discovery of the B and B deposit (Leonard, 1965) in 1964.

In the late 1970's, precious metals price increases again rekindled interest in the area. Reconnaissance evaluation and stream sediment sampling programs were conducted by the El Paso Natural Gas Company and Canadian Superior Mining Company on properties accessible from the Profile road. Currently (1983), Coeur d'Alene Mining Company is developing an open pit gold mine on property at the site of the old Sunnyside Mine (fig. 14) in the Thunder Mountain district and leased from Phillips Minerals and Thunder Mountain Gold Inc. In the Yellow Pine district, Superior Oil Company is producing gold from the West End Mine.

The largest producing mines in the region have been the Yellow Pine, Hermes-Cinnabar, and West End Mines in the Yellow Pine district, and the Dewey and Sunnyside Mines in the Thunder Mountain district. The Red Metal Mine in the Profile district produced 46 oz gold, 5,760 oz silver, 6,000 lb copper, and 2,170 lb lead from 1914 to 1946 (U.S. Bureau of Mines records). There has been no recorded production from claims inside or adjacent to the Pinnacles-Rainbow Peak unit. About 60 tons of lead-zinc ore was apparently mined but not shipped from the Central Galena property in the early 1930's (Cooper, 1943, p. 1). The Moscow, and Sunday Mines in the Edwardsburg (Big Creek) mining district produced about 640 oz gold, 1,260 oz silver, 1,100 lb copper, and 20,730 lb lead intermittently from 1907 to 1942 (U.S. Bureau of Mines records).

Valley County records indicate that at least 250 lode claims have been located in or adjacent to the Pinnacles-Rainbow Peak study areas. Approximately 80% of the claims are near the Profile Creek road within a large, complexly overlapping group of claims adjacent and roughly parallel to the western border of the Pinnacles study area. Most of the remaining lode claims lie near or adjacent to the wilderness boundary, but very few actually are within the Wilderness. In 1981, the entire Profile Gap area was staked by Gold Depository Loan Exploration and Mining Company of San Francisco, California, and System Fuels, Inc. of New Orleans, Louisiana. Many of these claims overlap existing lode claims. Eighteen patented lode mining claims known as the Central Galena Group, are located adjacent to the western boundary of Pinnacles study area (fig. 14), and form an alcove in the Wilderness north of Missouri Creek. Six placer claims have been located within the study areas.

Geologic Setting

The Pinnacles-Rainbow Peak unit is underlain by metasedimentary rocks, probably Precambrian in age, that were intruded by Cretaceous granite and granodiorite of the Idaho batholith and subsequently covered by Tertiary Challis Volcanics that emanated from the Thunder Mountain caldera (Mitchell and Bennett, 1979; Fisher and others, 1983). Challis Volcanics cover about 60% of the Pinnacles study area occupying the eastern and central portions, and nearly all of the Rainbow Peak area. Along the western and northwestern edge of the Pinnacles study area, swarms of Tertiary dikes and related silicified zones are associated with most known mines and prospects. Older metasedimentary rocks strike northwest and dip northeast at the far north end and in the southwestern third of the Pinnacles study area. Batholithic rocks crop out only in the extreme southwestern corner of the Pinnacles study area, except for a few isolated cupolas within metasedimentary rocks. The following is a brief description of the principal lithologic units.

Metasedimentary rocks include argillite, siltite, limestone and volcanic rocks of the Yellow Jacket Formation overlain by white quartzite and quartz pebble conglomerate of the Hoodoo Formation. In the Pinnacles study area the Yellow Jacket Formation shows metamorphic grades ranging from a biotite zone through andalusite and staurolite zones to a sillimanite zone.

Several varieties of batholithic rocks are found in or adjacent to the study areas. The largest intrusive masses are medium-grained equigranular granite and granodiorite. Also a mixed rock unit primarily consisting of sheets and cupolas of granite interleaved with tabular bodies of metasedimentary rock crop out over large areas in the southwest corner of the Pinnacles study area.

The Tertiary Challis Volcanics consist of rhyolite, latite tuff, mudflow debris, and volcanic breccia. Numerous rhyolite, latite, and diorite porphyry dikes are found in the western third of the Pinnacles study area.

Quaternary glacial and alluvial deposits occur within or adjacent to the major drainages, especially in Tamarack Creek.

The study areas are structurally complex. The metasedimentary rocks occur in broadly synclinal roof pendants that show an early set of northwest-trending folds that are cross-folded by northeast-trending structures (Leonard, 1957, p. 1876; Cater and others, 1973, p. 29). The northwest axis plunges from 5° to 20° northwest or southeast. Major folds range from upright open with vertical axial planes to overturned, isoclinal, with axial planes nearly horizontal (Leonard, 1957, p. 1867). Numerous small-scale, northwest-trending folds are conspicuous in outcrops. The Challis Volcanics display moderate dips resulting from deformation by open folds and normal northeast-trending faults (Cater and others, 1973, p. 23). The Tertiary dike swarm shows a dominant north-northeast trend; it apparently formed during Eocene collapse of the Thunder Mountain caldera and later northwest extension, and may be related to the large, well-mineralized northeast-trending shear zones of the Yellow Pine district. Wide-spread block faulting during the Miocence and Holocene has further complicated structural interpretation (Leonard, 1983).

Mines, Prospects and Mineralized Areas

Leonard (1983, p. 7) states that mineral deposits of gold, silver, mercury, antimony, and tungsten in the Thunder Mountain, Yellow Pine, and Edwardsburg (Big Creek) mining districts are structurally related to subsidence of the Eocene Thunder Mountain caldera complex. The major deposits occur within or close to silicified zones that are near the intersection of discontinuous ring and radial fractures of the subsiding complex (Leonard, 1983, p. 7). Leonard (1983, p. 8) classified most of the deposits of the region as xenothermal because of the unusual association of minerals, found in many of the deposits, that normally occur in widely different environments and because of the lack of regional metal zonation.

Mineral deposits in the Pinnacles-Rainbow unit and vicinity occur in veins, shear zones, and silicified zones, and as replacement bodies of base metals adjacent to faults. The deposits are characteristically irregular and discontinuous.

Mines, prospects, and areas of altered rock examined are shown on figure 14. Those sites with highly favorable geologic settings (Palmetto claim, and area south of Rainbow Peak) are described below; those sites with no apparent resources or which are not sufficiently exposed to permit evaluation are in table 5.

Palmetto Claim

The Palmetto Claim is approximately 1,200 ft east of Profile Gap (fig. 14, no. 5) and adjacent to but outside of the study area. The claim was patented on May 12, 1910 and is presently owned by the Missouri-Idaho Smelting company. The claim has no recorded production.

Weakly altered, moderately fractured, limonite stained and partly silicified granodiorite is exposed in the workings consisting of a caved adit, several small cuts (from early 1900's), and recent trenches made with a bulldozer (fig. 15). In area A, a 6-in.-thick stibnite vein is exposed. The vein strikes N. 40° E. and dips 55° SE. A silificied zone 6 ft wide forms the vein footwall. In area B, weakly silicified and altered granodiorite showing weak to moderate ferric-iron stain is exposed by trenching.

Preliminary geologic work indicates that silicified and argillized granodiorite (hydrothermal alteration) is widespread in the Palmetto Claim area. Samples from the altered granodiorite were from 6 ft to 10 ft long and had 0.010 oz/ton to 0.07 oz/ton gold, which indicates that the hydrothermal system contained gold. The stibnite vein is probably important only as an additional indicator of gold mineralization. Detailed sampling, especially drilling, in the area could delineate a significant disseminated gold deposit.

Area South of Rainbow Peak

The area is on a ridge approximately 5,700 ft S. 13° W. of Rainbow Peak (fig. 14, no. 14). The mineral occurrence is on or near the boundary between the former Idaho Primitive Area and the Rainbow Peak Unit. No prospects were found in the area, but there are local zones of fine grained quartz, cemented rhyolite breccia, and silicified ferric-iron-stained rhyolite that show argillic hydrothermal alteration. The breccia consists of fragments up to 1/2 in. across and occurs in zones up to 100 ft wide. Fifteen samples were taken from the area between Pyramid Point and Rainbow Peak (fig. 20), of which four were anomalous (24.79, 0.58, 0.3 and 0.16 ppm gold). Such samples may be indicators of a low-grade disseminated gold-silver deposit.

ASSESSMENT OF MINERAL RESOURCES

The Pinnacles-Rainbow Peak Unit is locally mineralized, particularly along its boundaries. The pattern and setting of the mineralization appear to be similar to that which formed the epithermal disseminated gold deposit at Superior Oil Company's West End Mine southwest of the unit. The most promising sites are the silicified and hydrothermally altered areas at the Palmetto Claim and the area south of Rainbow Peak. Both sites are partially inside the study area. Sample results from these areas indicate that low grade gold- and/or silver-bearing rock may extend over areas large enough to support limited open pit operations at gold prices of $400/troy oz.

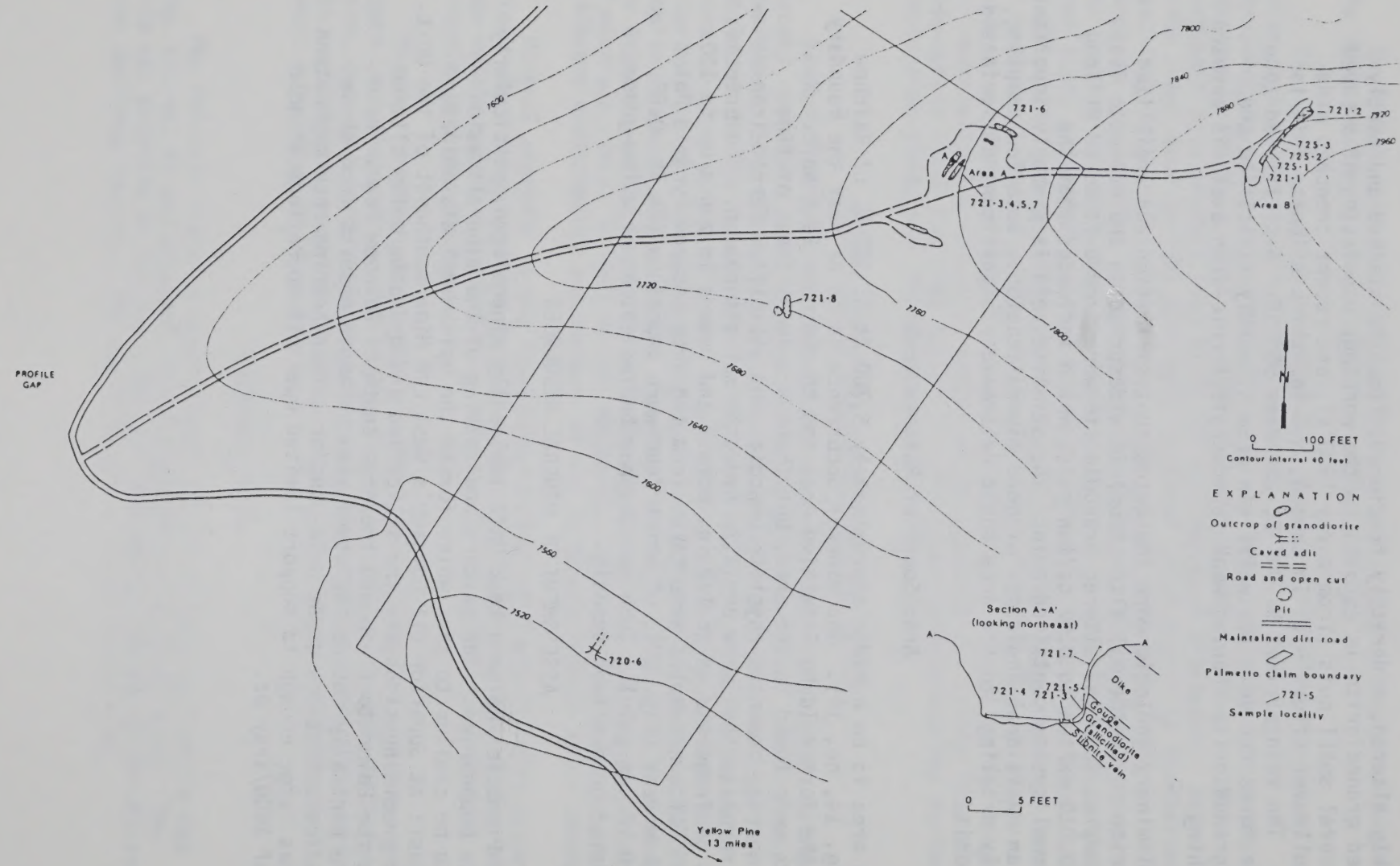


FIGURE 15.–Palmetto claim

An unnumbered table to accompany figure 15, Palmetto Claim

[N, none detected; --, not determined]

Sample No.	Type	Length (ft)	Description	Gold (oz/ton)	Silver (oz/ton)	Antimony (%)
			Area A			
721-3	Chip--	0.5	Stibnite vein in fine-grained quartz----------	0.138	0.2	23.0
721-4	do----	6.0	Footwall of stibnite vein. Weakly altered and silicified granodiorite----------	.062	.3	.06
721-5	do----	2.5	Hanging wall of stibnite vein. Silicified granodiorite and 6 in. of gouge----------	.054	N	.05
721-6	do----	10.0	Argillically altered, moderately fractured granodiorite----------	.01	.4	.02
721-7	do----	4.0	Dark-green aphanitic dike in hanging wall above stibnite vein----------	N	N	.05
			Area B			
721-1	do----	10.0	Coarse-grained, weakly silicified iron-oxide-stained granodiorite----------	.024	N	N
721-2	do----	9.0	Across east side of upper pit. Strongly fractured granodiorite with iron-oxide-stained fractures----------	.019	N	N
725-1	do----	10.0	Weakly silicified, iron-oxide-stained granodiorite----------	N	N	--
725-2	do----	10.0	Weakly silicified, iron-oxide-stained granodiorite----------	.01	N	--
725-3	do----	10.0	do----------	.07	N	--
720-6	Grab--	--	Granodiorite; composite from dump of main adit 200 ft northeast of old cabin near Profile Creek----------	N	N	--
721-8	Chip--	7.0	Strongly fractured, partly silicified granodiorite granodiorite with three 1-ft-wide iron-oxide-stained silicified zones----------	.014	N	.02

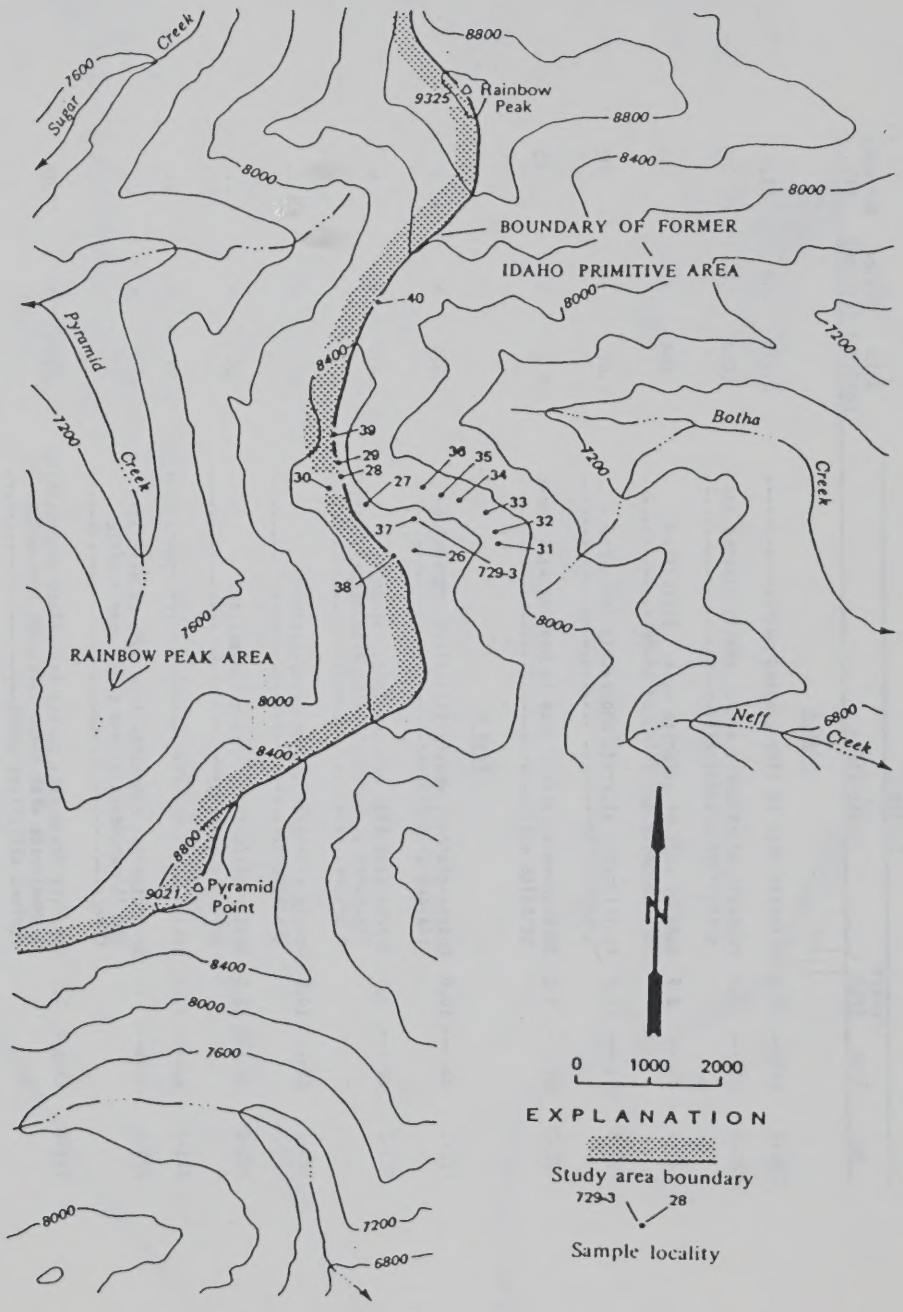


FIGURE 16.—Area south of Rainbow Peak

An unnumbered table to accompany figure 16, Area south of Rainbow Peak

[N, none detected; --, not determined]

Sample No.	Type	Length (ft)	Description	Gold (ppm)[1]	Silver (ppm)	Antimony (ppm)
27	Chip--	10.0	Outcrop of iron-oxide-stained, flow-banded, white rhyolite---	N	0.47	100
28	Grab--	--	Local zone of fine-grained quartz cementing breccia in rhyolite----------	N	2.34	150
29	Chip--	10.0	Same breccia zone as no. 28; representative sample across the zone----------	24.79	10.02	150
30	do----	10.0	Same zone as nos. 28 and 29, but appears opalized----------	N	N	150
31	do----	10.0	Banded, iron-oxide-stained rhyolite----------	N	N	150
32	Random chip--	--	White, silicified, iron-oxide-stained rhyolite from southeast side of basalt dike; some gouge material included.	N	N	150
33	do----	--	White, iron-oxide-stained rhyolite----------	N	N	N
34	Chip--	10.0	Argillically altered, strongly iron-oxide-stained rhyolite---	N	N	260
35	do----	15.0	Silicified rhyolite----------	N	N	100
36	Grab--	--	Silicified, iron-oxide-stained rhyolite----------	N	N	100
37	do----	--	Iron-oxide-stained, weakly silicified rhyolite----------	.30	1.92	N
38	do----	--	Argillically altered rhyolite--	N	N	N
729-3	Chip--	4.0	Iron-oxide-stained rhyolite; appears silicified then argillized----------	.58	6.86	--
39	do----	10.0	Flow banded rhyolite----------	0.16	N	150
40	Random chip--	--	Strongly silicified, brecciated iron-oxide-stained rhyolite---	.02	N	260

[1] One part per million (ppm) = 0.0001% or 0.029 troy oz/ton.

Table 5.--Mines, prospects, claims, and mineralized areas in the Pinnacles-Rainbow unit

[Asterisk (*) indicates outside study area]

Map no.	Name	Geology	Workings	Sample data
1	Freddie Claim*	Narrow quartz-filled fault in schist.	Caved adit.	One grab sample of quartz: no gold or silver detected.
2	Blue Bird, Blue Ribbon prospect*	Highly fractured welded tuff with strongly iron-oxide-stained fractures and occasional pyrite.	Adit 58 ft long.	One 10 ft chip sample: no gold or silver detected.
3	Profile Gap prospect* (Syringa)	Silicified "quartzite" or felsitic dike is intensely altered and stained with iron oxides. Boulders of limestone and quartzite breccia are scattered in the area.	One 50-ft-long trench.	One chip sample: 0.016 oz/ton gold and 0.2 oz/ton silver.
4	B and B prospect*	Replacements, fissure-fillings, and stockwork zones in a mylonized, sheared and brecciated belt of granodiorite intruded by a dike swarm. The sheeted quartz "vein" contains stibnite and cinnabar, strikes N. 30° to 40° E. and dips about 75° to 80° SE., and is in an area about 400 ft long and 30 ft wide (Leonard, 1965).	A sloughed, 400-ft-long bulldozer trench, and two caved adits.	Four samples: One grab sample of quartz vein material from the dump of an adit contained 0.026 oz/ton gold, 11.1 oz/ton silver, and 0.11% antimony; one 10-ft chip sample of silicified granodiorite contained 0.024 oz/ton gold and 3.2 oz/ton silver. One of two other chip samples of silicified granodiorite contained 0.4 oz/ton silver.
5	Palmetto Claim*	See text.		
6	Lotspiech Mine	Large cut is across an apparently faulted wedge of quartzite with minor limestone. The adit is in altered fine-grained quartzite mixed with "rhyolite;" pit uphill is in silicified pyrite-bearing limestone which strikes N. 10°-20° W. and dips 60° E., and has iron-oxide-stained fractures.	An open cut 100 ft long, a caved adit and a small pit.	One chip sample of silicified limestone and one grab sample of quartzite and rhyolite from the dump: no gold or silver detected.
7	Prospects north of Lotspeich Mine	Weakly-altered, iron-oxide-stained, fractured quartz monzonite has a few scattered 1/2-in.-thick quartz veinlets which are 1.5 to 3 ft apart and contains very sparsely disseminated pyrite.	Two caved adits, one shallow caved shaft.	Four samples of quartz monzonite: no gold or silver detected.
8	Prospect	Strongly fractured, moderately iron- and manganese-oxide-stained, welded rhyolite tuff.	One pit.	One grab sample: no gold or silver detected.

Table 5.--Mines, prospects, claims, and mineralized areas in the Pinnacles-Rainbow Peak unit--Continued

Map no.	Name	Summary	Number and type of workings	Sample data
9	Central Galena Group*	Limestone and quartzite cut by numerous felsite and aplite dikes. Lead-, zinc-, copper-, and silver-bearing minerals occur along faults, bedding plane seams and in narrow quartz veins in or adjacent to altered dikes. Occurrences are irregular and discontinuous, ranging from 4 in. to 5 ft thick and rarely longer than 30 ft (Cooper 1943).	Six adits ranging from a few feet to 360 ft in length, a 60 ft deep shaft, and numerous pits and trenches.	Eighteen samples: three samples of sheared quartzite near Spring Creek; one had 4 oz/ton silver, 0.53% copper, 6.9% lead, 20.5% zinc, and 0.02% cobalt, and another had 1.06% lead, 0.63% zinc. Two samples of sheared quartzite between Spring and Ryan Creeks; 0.70 oz/ton silver in one sample. Eleven samples of quartz veins, altered dikes, and shear zones near Ryan Creek; five had 0.006 oz/ton to 0.028 oz/ton gold and 0.5 to 2.4 oz/ton silver. Two samples between Ryan and Missouri Creeks; one had 2 oz/ton silver.
10	Prospect west of The Pinnacles	Silicified zones along faults in Challis Volcanics. Faults strike north and dip 80° W. The largest zone is about 100 ft wide and contains two strongly silicified zones approximately 10 and 12 ft thick. Abundant drusy quartz and iron-oxide stains occur in the strongly silicified zones.	Two adits each 20 ft long, and two pits.	Ten chip samples: no gold or silver detected.
11	Copper Cliff Group	Epidote gneiss is crosscut and altered by aplite and granitic dikes. Mineralized areas consist of 8-in.- to 3-ft-thick north-trending faults containing irregular and discontinuous pods and lenses of chalcopyrite and malachite, and 6- to 15-ft wide skarns containing chalcopyrite and malachite with minor amounts of pyrite and arsenopyrite adjacent to steeply dipping, northeast-trending faults.	Four adits (Baker, 1948), now caved, numerous small pits and trenches.	Twenty samples: 14 samples west of Missouri Ridge; 0.3 oz/ton silver in one, 0.1 to 0.64% copper in eight. Six samples east of Missouri Ridge; 0.09 and 0.3% copper in two.
12	Prospect	Altered, silicified felsite or quartzite is strongly brecciated and iron stained.	One pit.	One chip sample: no gold or silver detected; spectrographic analysis indicates 0.3% arsenic.
13	Rainbow Peak Prospect	Moderately to heavily iron-oxide-stained rhyolite contains 1/10 to 1/4 in. thick intersecting gray quartz veinlets. Chalcedony and drusy quartz-filled cavities are abundant. Scattered pyrite is associated with the quartz veinlets.	One pit.	Eight grab samples and one chip sample: no gold or silver detected.
14	Area south of Rainbow Peak	See text.		

Table 5.--Mines, prospects, claims, and mineralized areas in the Pinnacles-Rainbow Peak unit--Continued

Map no.	Name	Summary	Number and type of workings	Sample data
15	Prospect*	Outcrop of silicified, iron-oxide-stained rhyolite, but abundant quartz monzonite float covers heavily-forested area.	One caved adit.	One grab sample of silicified rhyolite: no gold or silver detected.
16	Prospect	Parallel fractures strike N. 50° E. and dip 50° to 60° NW in brecciated and silicified quartz monzonite. Moderate iron-oxide-stains and occasional pyrite occur.	One pit.	One chip sample: no gold or silver detected.

MINERAL APPRAISAL OF THE YELLOWJACKET UNIT, LEMHI COUNTY, IDAHO

by

Jerry E. Olson

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INTRODUCTION

Location and Access

The Yellowjacket 1/ unit is in the western part of Lemhi County approximately 35 air miles southwest of Salmon, Idaho (fig. 17). The area is bounded on the south by Yellowjacket Creek, on the east by Shovel Creek and Quartzite Mountain, and on the west and north by the Wilson Creek divide and the Crags campground area, respectively. Lower elevations are usually accessible via 60 miles of graded Forest Service roads from both Salmon and Challis, Idaho. Heavy snow cover restricts road access to the higher elevations from about October through June. Foot trails along Yellowjacket and Hoodoo Creeks, and on the divide between Black Eagle and West Fork Yellowjacket Creeks, provide access through the interior of the unit.

Setting

The unit lies within the Salmon River Mountains with elevations ranging from 4,500 ft on Yellowjacket Creek to 8,938 ft at the summit of McEleny Mountain. The area is drained by Yellowjacket Creek in the east and in the west by Hoodoo and Lake Creeks. Vegetation ranges from sagebrush and grass on the lower south facing slopes, to thick stands of fir, pine, and spruce and grassy meadows along Yellowjacket Creek.

Previous Investigations

Previous investigations of the geology and mining activity of the Yellowjacket mining district are provided by Sheldon (1912), Umpleby (1913c), Ross (1934), Anderson (1953, 1963a, 1963b), Bennett (1980a), and Carter (1981). An unpublished report on the Yellow Jacket (Steen) Mine was prepared by Kauffman (1970).

1/ The name Yellowjacket was once spelled as two words (Yellow Jacket) as in Umpleby (1913c). Ross (1934) appears to be the first author to refer to this name in its present form. The original spelling is retained for the properties of Yellow Jacket Mines, Inc. as shown on the patent plats.

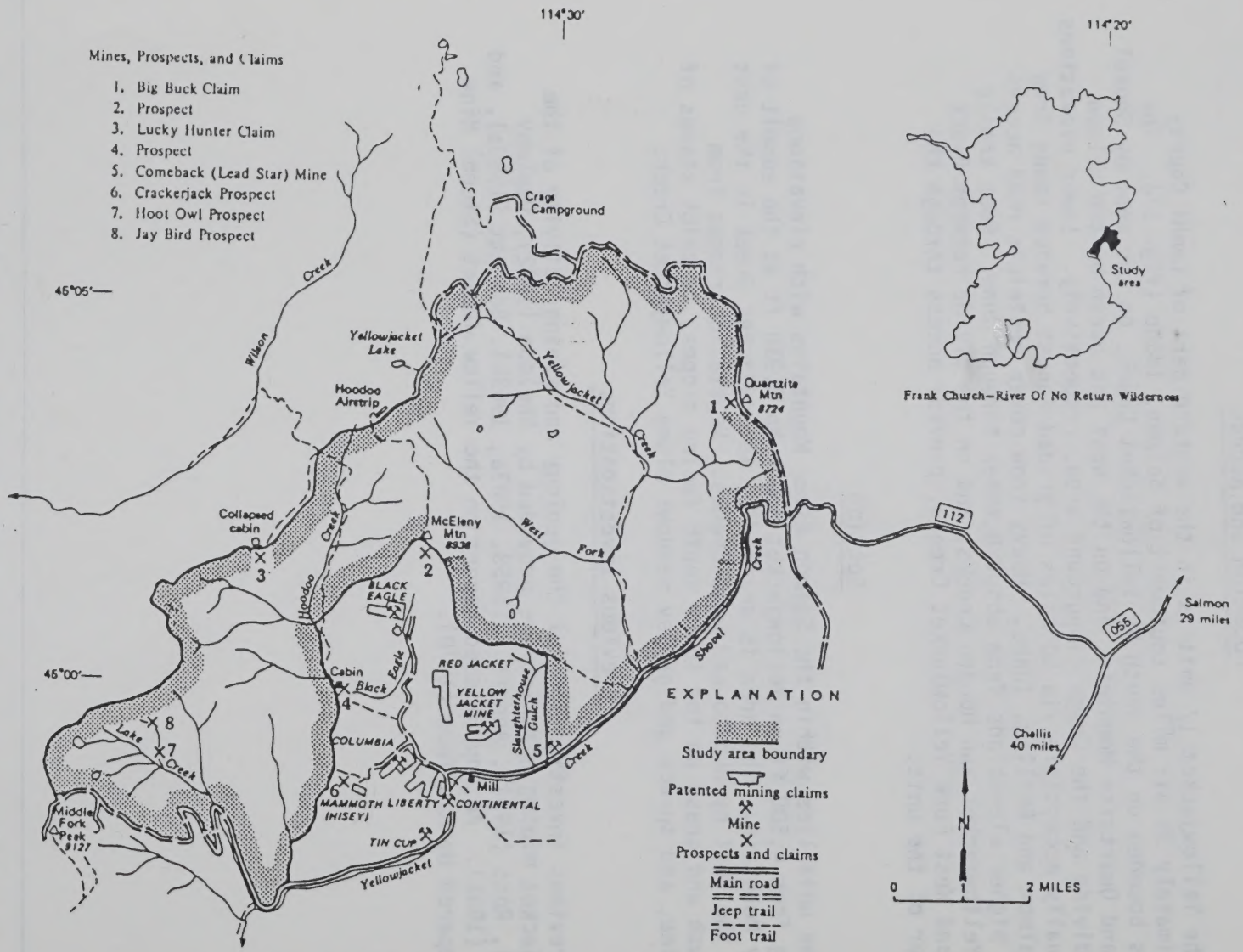

FIGURE 17.–The Yellowjacket unit, Lemhi County, Idaho

MINERAL APPRAISAL

Mining History

Mineral exploration in Lemhi County began in 1866 with the discovery of placer gold at Leesburg. In 1868, the discovery of placer gold in Yellowjacket Creek near the present Yellow Jacket millsite resulted in the discovery of the Yellow Jacket lode and the formation of the Yellowjacket mining district. This district encompasses most of the study area (fig. 3). The earliest known lode claim is dated September 29, 1869 (William Steen, 1983, personal commun.). Interest in the Yellow Jacket Mine was dominant until about 1890 when numerous other lodes were discovered and developed, most of which were located nearby. These included the Columbia and Continental Mines to the west, the Black Eagle Mine to the north, the Comeback (Lead Star) Mine to the east, and the Tin Cup Mine to the south (fig. 17); most of these properties are patented. Although all are lode claims, some minor placer activity occurred on Yellowjacket Creek and on nearby hillsides in eluvial deposits.

The history of the district is well documented and perhaps best described in terms of the development of the Yellow Jacket Mine. In 1876, a five-stamp mill was erected, and increased to ten stamps by 1882. This mill was destroyed by fire in 1894 and rebuilt by January 1895. Initially the new mill consisted of 20 stamps, but by January 1896 it had been gradually increased to 60. Although partially collapsed, most of the mill is still standing today. In 1893, an aerial tramway replaced ore haulage by wagon team from the mine to the mill, and a second tram was added in 1895.

Lode mining was at its peak between 1893 and 1897; but the mines began to close around the turn of the century and interest shifted to placers along Yellowjacket Creek. Placer activity, however, was shortlived and lode mining again became predominant.

In 1923, a promotion and development campaign was launched by the New York-Idaho Exploration Co. and an adit was driven 105 ft into the mountain near the Yellow Jacket mill to intersect ore at depth. In support of this, a large hotel was built and the mill refurbished, but because of a lack of funds all work was halted. Although partially collapsed, the hotel still stands a short distance from the mill.

In the 1930's, the mill was modernized, by-passing the stamps, and crushing, grinding, and flotation and concentrating facilities were added. All work terminated in 1942 as a result of Gold Mine Order L-208. In 1948, the Yellow Jacket Mine was repurchased by the Steen brothers whose father had owned and operated the mine between 1888 and 1892. In 1977, the Steen family incorporated its holdings, including the Columbia-Continental group, under the name of Yellow Jacket Mines, Inc., (William Steen, 1983, personal comm.).

Production in the Yellowjacket mining district from 1902 to 1949 (Anderson, 1953, p. 17) is summarized as follows: gold, produced primarily from the Yellow Jacket, Bryan, Steen Group, Tin Cup, and Black Eagle Mines totaled 3,855 oz; silver primarily from the Black Eagle, Yellow Jacket, Lead Star, Copper Glance, and Columbia Mines totaled 5,608 oz; copper, mostly from the Yellow Jacket, Bryan, Steen Group, and Copper Glance Mines, totaled 20,792 lb, and lead, produced from the Yellow Jacket, Bryan, Lead Star, and Copper Glance Mines, totaled 17,275 lb.

In 1970, Noranda Exploration Inc. conducted an induced polarization survey on the Yellow Jacket property and the Columbia-Continental group. The survey located a geophysical anomaly in the Columbia-Continental area which may indicate the presence of a conductive body at depth. During the summers of 1975 and 1976, a shallow air track drilling program was completed by Cyprus Mines Corp. (currently Cyprus Mining Division-Amoco).

Recent metallurgical tests by Heinen-Lindstrom Assoc. of Sparks, Nevada, has shown that eluvium and vein material at the Yellow Jacket Mine are amenable to cyanide heap leaching. In 1981, a small pilot plant was constructed and 109.26 oz of gold and 70.8 oz of silver were recovered from 3,000 tons of material by leaching and carbon absorption (William Steen, 1983, personal commun.).

Other mining in the district is limited to small-scale seasonal activity. None of this activity is inside the Wilderness.

Geologic Setting

The oldest rocks in the Yellowjacket unit are Precambrian metasediments correlated with the Belt Supergroup (Ruppel, 1975). These were intruded by the Cretaceous Idaho batholith. The Eocene age rocks include the Challis Volcanics and the Casto and Crags plutons.

The Precambrian Yellowjacket Formation, named for its proximity to the Yellow Jacket Mine (Ross, 1934, p. 16), is divided into two separate units: a greenish-gray calcareous hornfels, and a more predominant grayish-black argillaceous quartzite (Carter, 1981, p. 16-29). The Hoodoo Formation, named for its occurrence at Hoodoo Creek (Ross, 1934, p. 18) is a fine- to medium-grained, white-gray, very resistant quartzite. The Hoodoo overlies the Yellowjacket and is considered younger, but locally the contact between these two formations has been described by Ross (1934, p. 73), and Carter (1981, p. 83-84) as a thrust fault. These two formations comprise approximately half of the exposed rocks in the unit. A belt of Cretaceous igneous rock, about 1 1/2 miles wide (Rember and Bennett, 1979), extends approximately 3 miles into the unit from the west-central boundary. This intrusive body is described by Cater and others (1973, p. 19-20) as quartz monzonite and quartz diorite of the Idaho batholith. Immediately to the north and in contact with the batholith is the Eocene Crags pluton. It comprises most of the northern part of the study area and is composed of medium-grained quartz monzonite grading into granodiorite (Cater and others, 1973, p. 24-26). Challis Volcanics and associated dikes are evident throughout the unit and are especially conspicuous near the Columbia Mine on what is locally known as "Columbia Hill."

Much is written on structures in the Yellowjacket district, but most studies concentrated on the areas surrounding the Yellow Jacket-Columbia mineralized complex. Therefore, structures in the unit are extrapolated by inference from data given on the Yellowjacket district as described below.

Geologic observations indicate that folding of the Hoodoo and Yellowjacket Formations occurred sometime in the late Precambrian (Carter, 1981, p. 78), creating a north-northwest-trending fold with gently dipping limbs. Noranda Exploration Inc. geologists, working in the Blackbird district to the northeast (fig. 3), attributed much of the folding to soft sediment deformation (Carter, 1981, p. 78). Ross (1934, p. 72-73), suggests that bedding between Hoodoo and Yellowjacket Creeks indicates a northwest-trending anticline.

Faults are pervasive and are summarized by Anderson (1953, p. 12-14) who defines four main episodic types:

1) Dike faults

   a) Late Precambrian faults, tensional normal, trending northwest and northeast and intruded by dikes.

   b) Cretaceous faults, similar to above

   c) Mid-Tertiary dikes trending northeast

2) Mineralized faults trending east-northeast on Yellowjacket Hill and west-northwest in the Columbia Mine area.

3) Post mineral faults cutting mineralized structures throughout the district; these strike N. 20° E. and dip 32° SW. on Yellowjacket Hill.

4) Other regional faults, including the thrust fault contact between the Yellowjacket and Hoodoo Formations.

Mines and Prospects

Mineral deposits in the Yellowjacket mining district occur as veins, lodes, and stockworks, principally in the Yellowjacket Formation and, to a lesser extent, in the Hoodoo Formation. Other deposits occur in Tertiary(?) igneous rocks. The area is generally considered a gold district, but silver (in tetrahedrite) and some base metals have been mined.

The majority of deposits in Precambrian rocks are interpreted by Anderson (1953, p. 18) to be related to Precambrian folding and fracturing which provided the necessary conduits for mineralizing fluids (Carter, 1981, p. 103). Two major fracture systems exist, one east-northeast at the Yellow Jacket Mine and another west-northwest in the Columbia-Continental area. Vein deposits at the smaller mines and prospects do not follow any apparent trend. The most generally accepted theory is that the source of the mineralizing fluids was magmatic. The mineralization is thought to have occurred in the Tertiary, probably during the waning stages of the Challis episode (Carter, 1981).

A search of Lemhi County records indicated approximately 40 lode and 18 placer claims or claim groups located from about 1890 to present, are within or adjacent to the unit, in addition to patented claims or those associated with the Yellow Jacket-Columbia Group properties. Bureau of Land Management records show that assessment work has been done on six of the claims during the two years prior to 1983. Efforts to find claims resulted in the delineation of 13 previously worked and/or mineralized areas. A total of 113 samples were taken both from these claims and from zones found to be mineralized. Most significant mines, prospects, and claims are described on the following pages; those not sufficiently exposed or with insufficient data to allow evaluation are listed in table 6.

Comeback (Lead Star) Mine

The Comeback Mine (fig. 17, no. 5) is about 1/4 mile north of Yellowjacket Creek near the mouth of Slaughterhouse Gulch. Bureau of Land Management records indicate the property was active in 1983. Workings consist of at least two caved adits, one caved glory hole, and numerous bulldozer cuts (fig. 18). Anderson (1953, p. 39) reports underground development of a least 150 ft in the lower adit; but, the size of the dumps indicate that this figure is conservative.

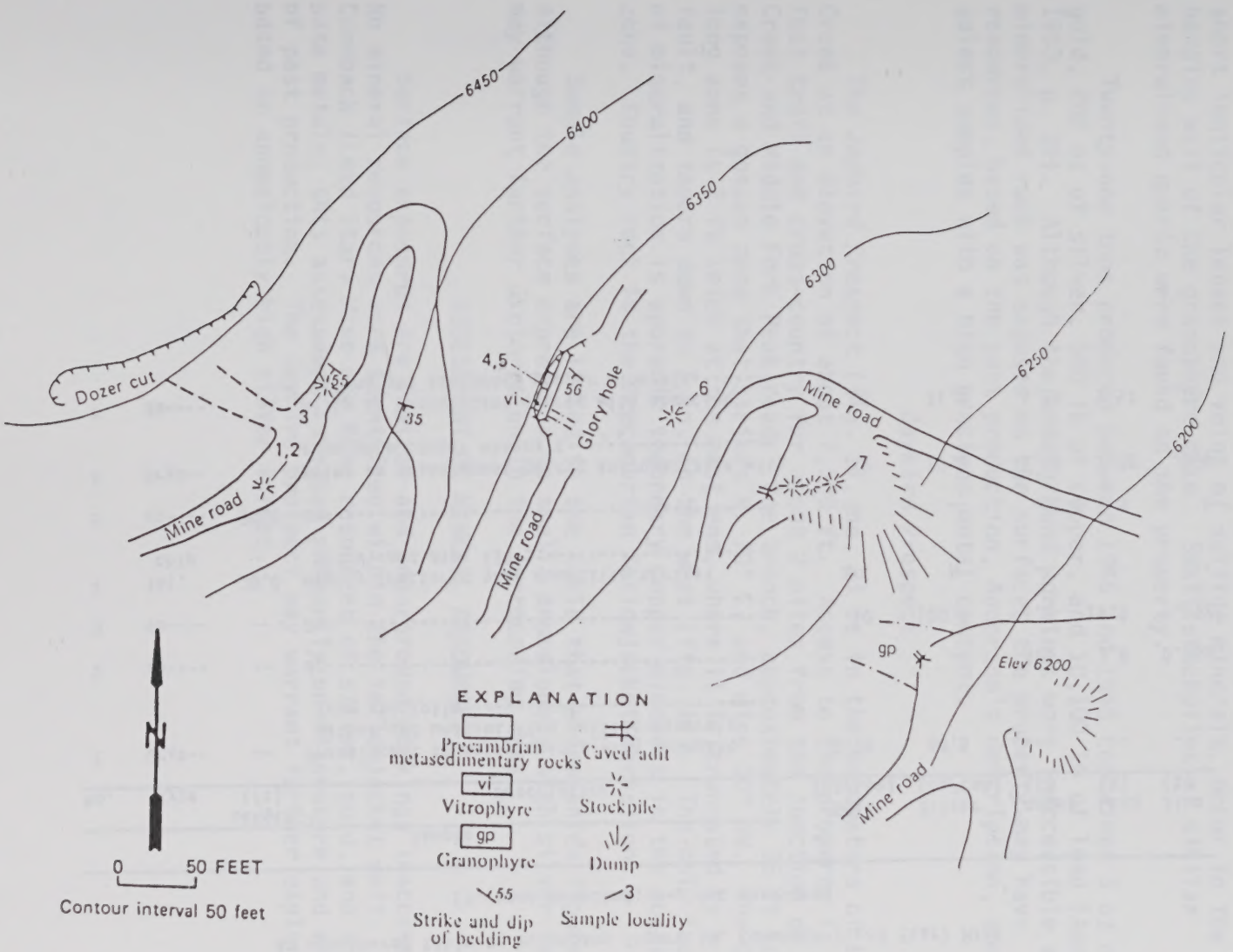

FIGURE 18.–Comeback (Lead Star) Mine

An unnumbered table to accompany figure 18, Comeback (Lead Star) Mine

[N, none detected; --, not analyzed]

Sample No.	Type	Length (ft)	Description	Gold (oz/ton)	Silver (oz/ton)	Copper (%)	Lead (%)	Zinc (%)
1	Grab--	--	Translucent to milky quartz with abundant galena and unidentified sulfide minerals from stockpile----------	0.09	64.5	--	--	--
2	do----	--	do----------	--	--	3.0	3.6	0.068
3	do----	--	do----------	.10	100.4	4.2	15.9	.092
4	Int. chip	30.0	Highly fractured gray quartzite strikes 55° W. and dips 43° S.----------	N	N	--	--	--
5	do----	30.0	do----------	--	--	.0070	N	N
6	Grab--	--	Milky to translucent quartz and quartzite with supergene copper minerals----------	.12	10.4	1.04	2.22	.056
7	do----	--	Milky to translucent quartz with abundant galena and secondary copper minerals--------	.04	31.0	1.24	2.57	.10

Precambrian metasedimentary rock is cut locally by one large granophyre dike exposed at the lower adit and a smaller vitrophyre dike in the glory hole (Anderson, 1953, p. 39). No mineralized rock was observed in place, but Anderson (1953, p. 39) reported that the ore, short lenticular lenses and veins of sulfide minerals, occur in the hanging wall of the granophyre dike. Small stockpiles of similar mineralized quartz were found on the property.

Twenty-one tons produced between 1946 and 1948 contained 3 oz of gold, 802 oz of silver, 500 lb of copper, and 10,100 lb of lead (Anderson, 1953, p. 39). Although the underground workings were inaccessible and no mineralized rock was exposed on the surface, the property may have resources, based on the past production, Anderson's description, and select samples with a high precious metal content.

Jaybird Prospect

The Jaybird Prospect (fig. 17, no. 8) is in the headwaters of Lake Creek at an elevation of about 7,500 ft. Access to the property is by foot trail and cross-country for about 2 miles from the junction of Lake Creek and Middle Fork Peak road. One trench, approximately 35 ft long, exposes a gossan zone that strikes N. 70° E. and dips 30° NW. The 25-ft long zone is 2 ft thick at the east end, where it is truncated by a fault, and tapers down to 1 in. on the west (fig. 19). The only indication of mineralization is sporadic secondary copper minerals in the gossan zone. Country rock is the Precambrian Yellowjacket Formation.

Sample analyses are listed in the table that accompanies figure 19. Although the surface expression is small, anomalously high silver values may warrant further exploration in the surrounding area.

ASSESSMENT OF MINERAL RESOURCES

Surface exposures are limited and underground workings inaccessible. No mineral resources were identified within the Yellowjacket unit. The Comeback (Lead Star) Mine may have resources of silver, gold, and some base metals; this assessment is based primarily on literature and records of past production. The Jaybird prospect may warrant further exploration based on anomalously high silver values.

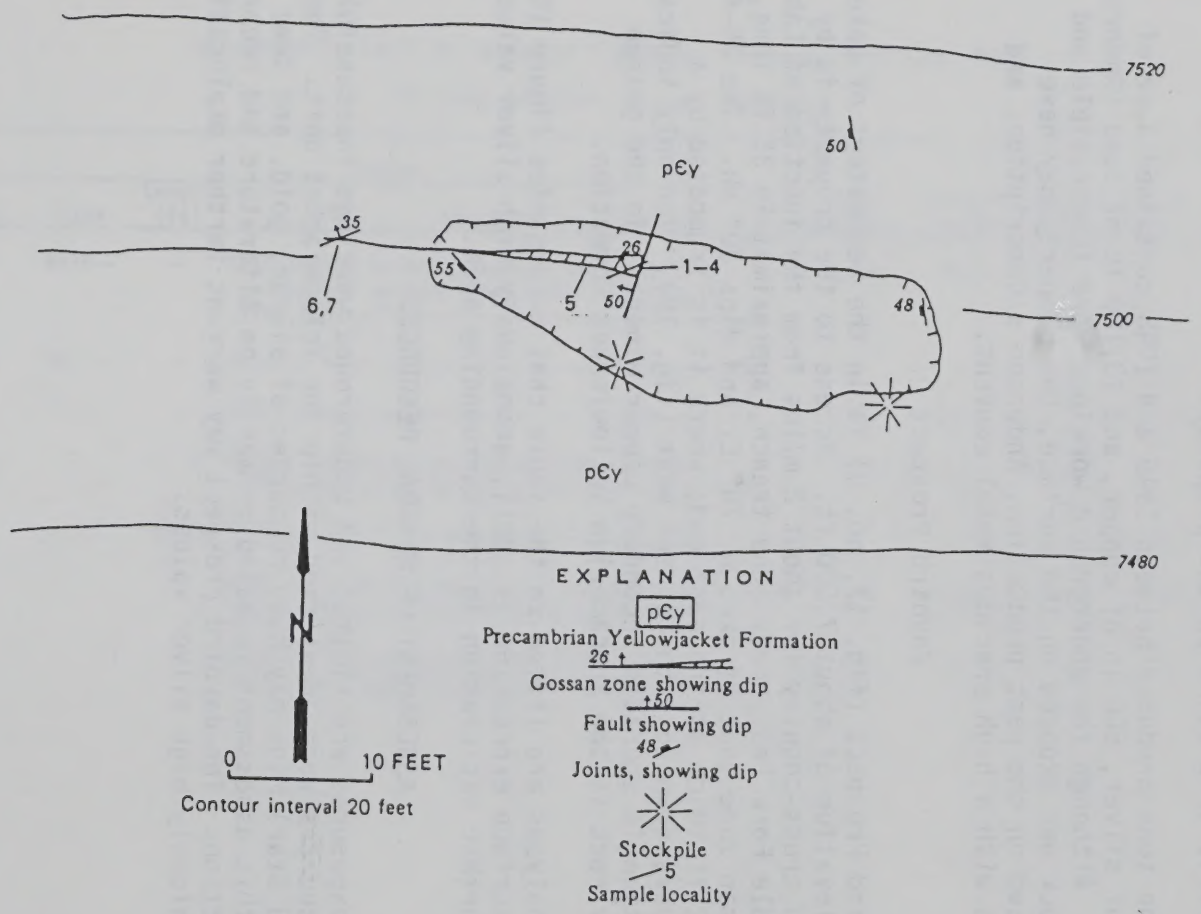

FIGURE 19.–Jaybird Prospect.

An unnumbered table to accompany figure 19, Jaybird Prospect

[N, none detected; --, not analyzed]

Sample No.	Type	Length (ft)	Description	Gold (oz/ton)	Silver (oz/ton)	Copper (%)	Lead (%)	Zinc (%)
1	Chip--	2.0	Brown-gray, aphanitic gossan zone in Yellowjacket Formation. Zone contains spotty patches of copper oxides----------	N	17.7	--	--	--
2	do----	2.0	do----------	--	--	1.37	0.235	0.10
3	do----	2.0	do----------	N	18.5	--	--	--
4	do----	2.0	do----------	--	--	.33	.28	.17
5	do----	1.2	do----------	N	2.3	--	--	--
6	do----	.7	Brown-gray gossan----------	N	13.0	--	--	--
7	do----	.3	do----------	N	3.3	--	--	--

Table 6.--Mines, prospects, and claims in the Yellowjacket unit

[Asterisk (*) indicates outside study area]

Map no.	Name	Summary	Workings and production	Sample and resource data
1	Big Buck Claim	A 50- to 100-ft-wide zone of altered quartzite; no apparent structures.	None.	Five grab and two chip samples: one grab sample contained 0.004 oz/ton gold and 0.22 oz/ton silver; another grab sample contained 0.55% lead and 0.022% lead and 0.022% molybdenum.
2	Prospect*	Brown, vuggy gossan and silicified gossan; minor pyrite occurs in brecciated and altered quartzite.	Three pits.	Three select samples and one chip sample of gossan: no gold detected; silver, in all samples, ranged from 0.2 to 0.3 oz/ton.
3	Lucky Hunter Claim	A 50- to 100-ft-wide gossan zone in quartzite cut by small veins and veinlets of quartz.	One collapsed cabin, six pits, and one adit.	Eight chip and two grab samples; four chip samples of quartz-bearing gossan contained gold ranging from 0.01 to 0.29 oz/ton and silver ranging from 0.01 to 0.15 oz/ton. Two grab samples of quartz gossan contained 0.1 and 0.26 oz/ton gold and 0.3 and 0.03 oz/ton silver.
4	Prospect*	White- to buff-colored quartzite has minor breccia and iron-oxide stains.	One cabin; no workings.	One select sample: 0.001 oz/ton gold and 0.005 oz/ton silver.
5	Comeback (Lead Star) Mine	See text.		
6	Crackerjack* Prospect	Small outcrops of quartz veins and veinlets within syenite country rock.	Two pits, one adit and one cabin.	Five grab samples of quartz: four had from 0.008 to 0.04 oz/ton gold; three had from 0.02 to 0.1 oz/ton silver. One had 1.64% copper.
7	Hoot Owl Prospect	Quartz float and silicified shear zones in quartzite.	One 50-ft-long trench; one 4-ft-long adit.	One chip, one grab and two select samples: one select sample of quartz float contained 0.001 oz/ton gold; two select, one grab, and one chip sample of silicified, sheared country rock contained from 0.003 to 0.012 oz/ton silver.
8	Jaybird Prospect	See text.		

MINERAL APPRAISAL OF THE UPPER MIDDLE FORK UNIT, CUSTER AND VALLEY COUNTIES, IDAHO

by

Spencee L. Willett

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INTRODUCTION

Location and Access

The Upper Middle Fork unit encompasses about 163,500 acres in the southwestern sector of the Frank Church-River of No Return Wilderness (fig. 20). Highway 21, connecting Boise and Stanley, provides access to gravel roads and trails in the eastern and southern portions of the unit which is approximately 120 miles northeast of Boise and 20 miles northwest of Stanley, Idaho. A gravel road leads from Lowman, approximately 25 miles through Bear Valley, to the southern boundary of the unit. Dagger Creek road, the main access route to the central part of the unit, extends approximately 10 miles north from the Landmark-Stanley road. Artillery Dome road on Pistol Creek Ridge constitutes part of the unit boundary to the north and serves as an access route to trails in that area. This road begins at Landmark, Idaho and follows Sand Creek until it terminates at the Lucky Lad Mine, approximately 28 miles.

Numerous foot trails within the unit are generally poorly maintained and difficult to follow. Gravel roads and foot trails are usually closed from November to May due to snow accumulation.

Sulphur Creek and Morgan airstrips, located west of the Middle Fork Salmon River, allow limited access to the unit by small aircraft.

Setting

The terrain ranges from rugged and spectacular mountains east of the Middle Fork Salmon River to rolling hills and large grassy meadows west and south of the river. Most tributary canyons have been glaciated above 8,000 ft elevation. Cirque lakes commonly lie at the heads of the glaciated canyons, particularly on the east side of the Middle Fork.

The dominant physiographic feature is the Middle Fork Salmon River which flows through the unit from south to north. The river loses about 1,000 ft in elevation from the confluence of Marsh and Bear Valley Creeks to the unit's north boundary near Sheepeater Hot Springs.

Elevations range from 9,407 ft at Ruffneck Peak to 5,200 ft on the Middle Fork Salmon River near the northern boundary. Large meadows located to the west and south range in elevation from 6,400 ft to 7,000 ft.

Ponderosa pine and Douglas fir cover most ridges, north slopes and steep-sided valleys. Ridges and peaks above 8,000 ft are mostly rugged and bare of vegetation. South slopes are drier and covered with bunch grass and sagebrush, and aspen groves around streams.

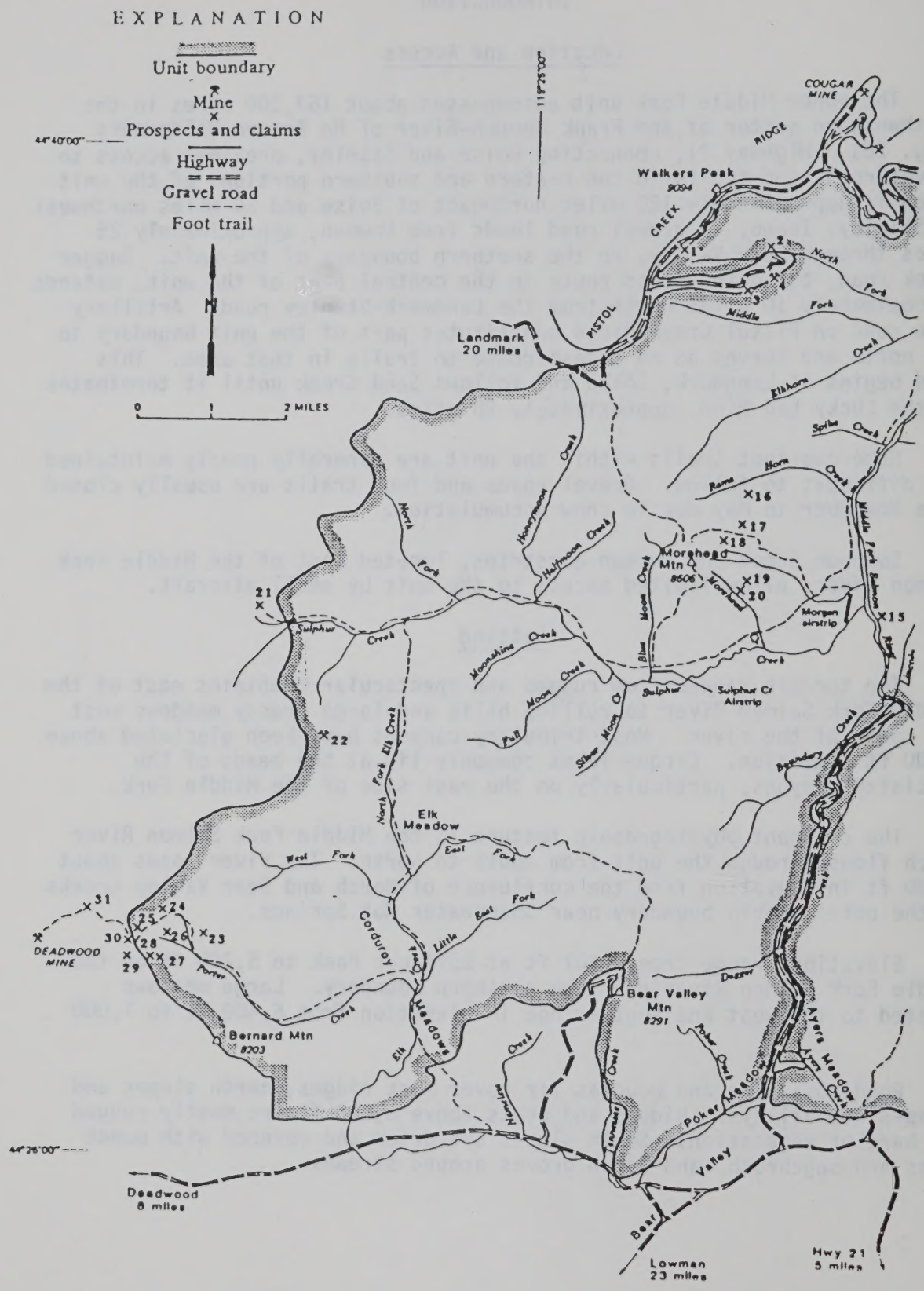
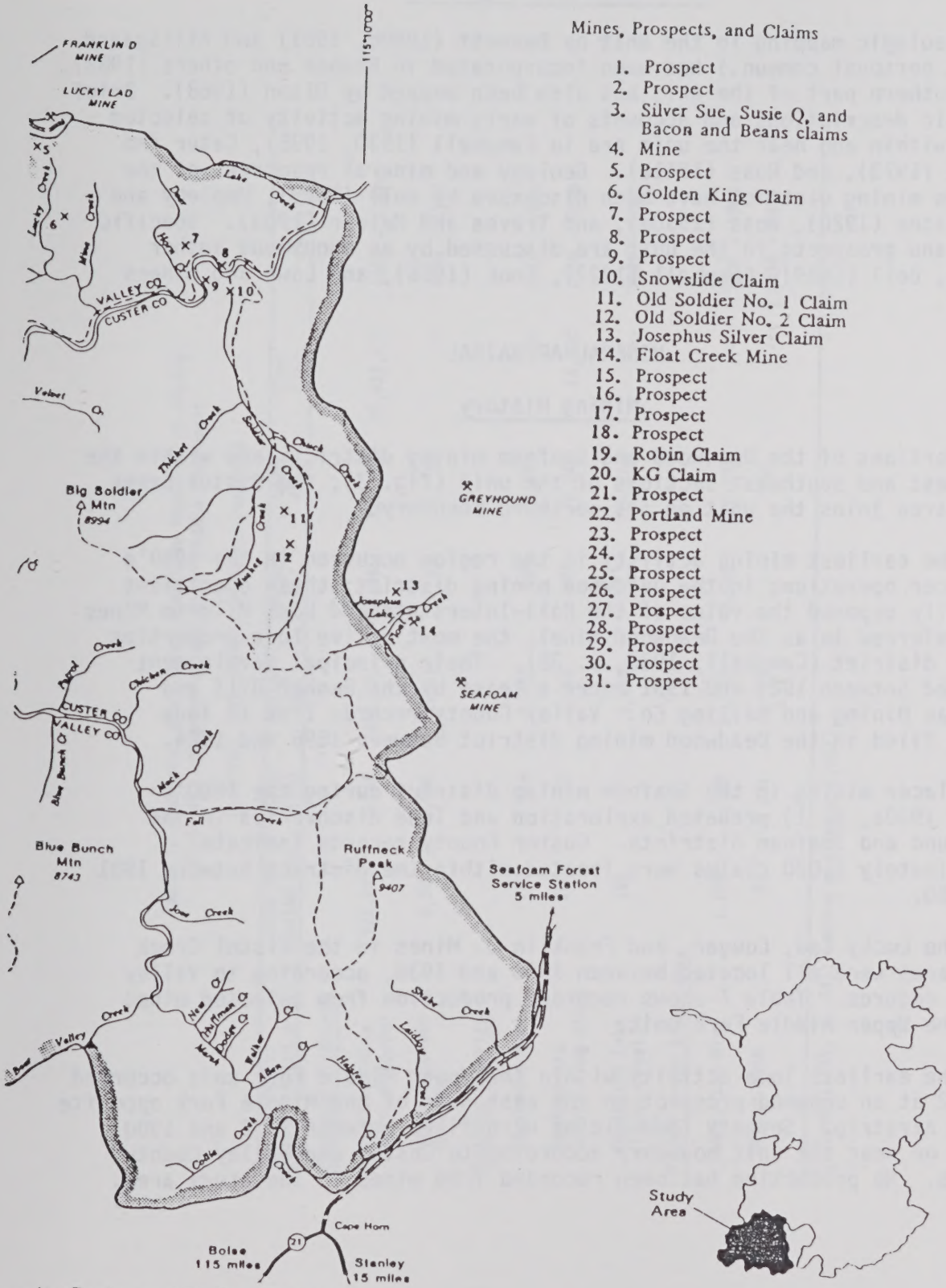


FIGURE 20.—The Upper Middle Fork



Mines, Prospects, and Claims

1. Prospect
2. Prospect
3. Silver Sue, Susie Q, and Bacon and Beans claims
4. Mine
5. Prospect
6. Golden King Claim
7. Prospect
8. Prospect
9. Prospect
10. Snowslide Claim
11. Old Soldier No. 1 Claim
12. Old Soldier No. 2 Claim
13. Josephus Silver Claim
14. Float Creek Mine
15. Prospect
16. Prospect
17. Prospect
18. Prospect
19. Robin Claim
20. KG Claim
21. Prospect
22. Portland Mine
23. Prospect
24. Prospect
25. Prospect
26. Prospect
27. Prospect
28. Prospect
29. Prospect
30. Prospect
31. Prospect

unit, Custer and Valley Counties, Idaho

Previous Investigations

Geologic mapping in the unit by Bennett (1980b, 1981) and Kiilsgaard (1983, personal commun.) has been incorporated in Fisher and others (1983). The southern part of the unit has also been mapped by Olson (1968). Brief geologic descriptions and accounts of early mining activity of selected areas within and near the unit are in Campbell (1930, 1935), Cater and others (1973), and Ross (1941a). Geology and mineral resources of the Seafoam mining district have been discussed by Bell (1919), Umpleby and Livingston (1920), Ross (1930a), and Treves and Melear (1953). Specific mines and prospects in the unit are discussed by an anonymous author (1925), Bell (1929), Campbell (1927), Cook (1956), and Lowe and others (1983).

MINERAL APPRAISAL

Mining History

Portions of the Deadwood and Seafoam mining districts are within the southwest and southeast sections of the unit (fig. 3); the Pistol Creek Ridge area joins the unit on its northern boundary.

The earliest mining activity in the region occurred in the 1860's at placer operations in the Deadwood mining district; these operations initially exposed the veins of the Hall-Interstate and Lost Pilgrim Mines (now referred to as the Deadwood Mine), the most active lode properties in the district (Campbell, 1930, p. 32). Their principal development occurred between 1924 and 1931 under a lease by the Bunker Hill and Sullivan Mining and Milling Co. Valley County records list 17 lode claims filed in the Deadwood mining district between 1896 and 1924.

Placer mining in the Seafoam mining district during the 1880's (Ross, 1930a, p. 1) predated exploration and lode discoveries in the Greyhound and Seafoam districts. Custer County records indicate approximately 1,020 claims were located within the district between 1881 and 1980.

The Lucky Lad, Cougar, and Franklin D. Mines in the Pistol Creek Ridge area were all located between 1933 and 1938, according to Valley County records. Table 7 shows recorded production from selected mines near the Upper Middle Fork unit.

The earliest lode activity within the Upper Middle Fork unit occurred in 1902 at an unnamed prospect on the east side of the Middle Fork opposite Morgan airstrip. Seventy lode claims were filed between 1902 and 1980 within or near the unit boundary according to Custer and Valley County records. No production has been recorded from mines in the study area.

Table 7.--Recorded production from lode deposits in mining districts adjacent to the Upper Middle Fork unit

(source: U.S. Bureau of Mines records)

Producer (district and mine)	Tons of treated ore	Gold (oz)	Silver (oz)	Copper (lb)	Lead (lb)	Zinc (lb)	Year(s)
Deadwood district							
Deadwood Mine (Lost Pilgrim)	125,293	2,768	683,173	480,055	525,962	10,951,833	1929 - 1950
Merry Blue and Union 1/	3,508	3,081	1,315	19	99	--	1901 - 1942
Seafoam district							
Greyhound Mine	223	235	8,727	665	22,653	--	1916 - 1940
Seafoam and Silver King Mines	213	210	1,560	435	11,243	16,000	1920 - 1958
Josephine Lake (Float Creek)	166	51	5,640	--	12,560	--	1939 - 1940
Pistol Creek Ridge area							
Lucky Lad Mine	1,138	1,309	24,165	3,069	322,732	--	1935 - 1942
Cougar Mine	81	183	433	--	341	--	1936 - 1937

1/ Cook (1956, p. 33); Lemmon and Tweto (1962).

Geologic Setting

The Upper Middle Fork unit is underlain by Cretaceous granite and granodiorite of the Idaho batholith (Atlanta Lobe). The most common rock types are biotite granodiorite with scattered areas of hornblende-biotite granodiorite, muscovite-biotite granodiorite, leucocratic granite, and porphyritic granodiorite (Fisher and others, 1983; Kiilsgaard and Lewis, 1983).

In the northern half of the unit, batholithic rocks have been intruded by the northeast-trending Tertiary Rapid River pluton, a dacite and diorite complex (Bennett, 1980b, 1983); Tertiary dacitic and rhyolitic dike swarms occur east and west of the pluton with dacite being the most common rock type.

A large quartzite roof pendant has been intruded by a Tertiary diorite stock and rhyolite, diorite, and latite porphyry dikes in the Cape Horn-Ruffneck Peak-Blue Bunch Mountain vicinity (Olson, 1968, p. 50).

Small pendants of quartzite and foliated schist in batholithic rocks occur in the southwest corner of the unit. Quartz-filled fissure veins cut the granodiorite host rock and roof pendants around the Bernard Basin and Portland Mine areas.

Faults in the region strike north, northwest, and northeast (Kiilsgaard and Lewis, 1983). Olson (1968, p. 105) associates the northwest-trending structures with the Sawtooth Fault. Northeast-trending structures are prominent in the Upper Middle Fork unit and control intrusions of the Idaho Porphyry Belt (Olson, 1968, p. 5). According to Kiilsgaard and Lewis (1983), northwest-trending faults terminate against a major set of northeast-trending faults that extend across the batholith. In the Pistol Creek Ridge area, faults strike N. 40° to 80° W. and have been displaced by northeast-trending cross-faults and Tertiary dike swarms (Cater and others, 1973).

The Cape Horn-Blue Bunch Mountain area to the southeast is described as a structural intersection where major northwest-trending pre-dike structures cross a zone of northeast-trending faults (Olson, 1968, p. 117).

Mines and Prospects

Kiilsgaard and Bennett (1983) conclude that most mineral deposits in the Atlanta lobe of the Idaho batholith are related to Tertiary intrusive rocks and controlled by regional faults. Two significant mineral deposits, the Greyhound Mine and Seafoam Mine group, lie a mile or less outside the eastern boundary of the Upper Middle Fork unit. Both deposits consist of quartz-filled fissure veins and lenticular cavities containing gold-silver-lead-zinc-copper minerals (Lowe and others, 1983). Host rocks are Cretaceous granodiorite and quartz monzonite intruded by Tertiary rhyolite and dacite dikes; the rocks are silicified and sericitized in and near the lodes (Olson, 1968). Mineralization was controlled by northwest-trending shears.

The most significant mineral deposit to the west is the Deadwood Mine located within a mile of the unit boundary. Lead-zinc-silver ore consists of sphalerite, galena, and tetrahedrite in a gangue of quartz, siderite, and crushed wallrock (Campbell, 1930) within quartz lenses in a fissure zone near schist roof pendants. Cretaceous granodiorite of the Idaho batholith encloses the deposit. The mineralized zone is controlled by two northeast-trending, near-vertical faults.

The Lucky Lad, Cougar, and Franklin D. Mines in the Pistol Creek Ridge area, north of the unit boundary, are gold-silver-copper-lead deposits. Highly oxidized ore occurs in vuggy quartz veins and in finely ground to blocky, iron-oxide-stained calc-silicate rock breccia (Cater and others, 1973, p. 213). Primary minerals include pyrite, galena, and tetrahedrite with lesser amounts of arsenopyrite, chalcopyrite, and sphalerite. Mineralization was controlled by irregular northeast-trending fissures within northwest-striking faults.

A total of 198 lode samples was collected from 30 mine and prospect sites within or in close proximity to the Upper Middle Fork unit. Mines and prospects are described and sample results presented in table 8.

ASSESSMENT OF MINERAL RESOURCES

Field observations and assay results suggest gold and silver resources may be present at several prospects in the Upper Middle Fork unit although individual occurrences may be small. Minor amounts of sulfide minerals (<5%) and various amounts of precious metals occur sporadically at these prospects on or near contacts between Tertiary dikes and batholithic rocks, and in quartz-filled fissure veins in batholithic rocks and roof pendants. However, these fissure veins, fractures, shears and contacts which controlled mineralization are discontinuous or irregular within the unit. Highly mineralized zones in adjacent mines and prospects and mining districts apparently do not continue along strike into the unit, but there are similarities in modes of occurrence.

Although no resources were identified at sites in and near the unit, several sites warrant further study. The Snowslide Claim and three unnamed prospects near Sheepeater Bar are on strike with a major regional trend encompassing the Greyhound Mine; samples taken from these four sites have anomalous gold-silver values. Samples from the Old Soldier and Josephus Silver Claims and the Float Creek Mine, on a structural trend parallel with the Greyhound trend, also contain anomalous precious metal values.

Table 8.--Mines, prospects, and claims within and adjacent to the Upper Middle Fork

[Asterisk (*) indicates outside study area]

Map no.	Name	Geology	Workings and production	Sample and resource data
1	Prospect	Five-ft-thick, 10-ft-long hydrothermally altered shear zone strikes N. 25° W., dips 70° NE, and contains a 1-ft-thick discontinuous zone of bull quartz in granodiorite host rock.	Two collapsed adits, 30 ft and 10 ft long.	One grab sample of altered host rock and quartz: 0.122 oz/ton gold and 3.9 oz/ton silver; one chip sample across shear zone: no gold or silver detected.
2	Prospect	Fracture zone 2.9 ft thick strikes N. 45° W., dips 69° NE., and contains minor iron-oxide stains in porphyritic granodiorite host rock.	One inclined shaft caved at 30 ft.	One chip sample of fracture zone and one grab sample of altered host rock: no gold or silver detected.
3	Silver Sue, Susie Q, Bacon and Beans Claims	Intersection between two joint sets in silicified, decomposed granodiorite. Joints strike N. 62° E. and N. 67° E. and dip 73° NW. and 40° SE. Pyrite and galena are visible in host rock and dump material at the Bacon and Beans site only.	Three caved adits estimated to total 80 ft long; five small pits.	Three chip samples, two grabs and one select sample: one chip sample contained 0.01 oz/ton gold; no gold detected in the other samples. Two yielded 0.1 oz/ton silver and four samples yielded 0.3, 3.2, 4.6, and 27.4 oz/ton silver; the highest silver value was derived from a select grab sample of high-grade dump material.
4	Mine	Ten-in. to 1.3-ft-thick fault zone strikes N. 35° - 50° E. and dips 60° SE. in porphyritic granodiorite intruded by Tertiary dacite dikes. Fault zone exposed in a 20-ft-long drift strikes N. 65° W. and dips 87° NE. contains pyrite.	One adit 586 ft long; one caved adit over 30 ft long, and four pits. Evidence of production, although none has been recorded.	Eleven chip samples and four grab samples: one chip and one grab sample of quartz vein material contained 0.01 oz/ton gold and one chip sample from drift contained 0.038 oz/ton gold; five chip samples of shear zone material yielded silver values ranging from 0.2 to 1.8 oz/ton and one grab sample of altered quartz yielded 2.1 oz/ton.
5	Prospect	Buff colored rhyolite dike has minor iron-oxide stains.	One small pit.	One grab sample: 0.1 oz/ton silver; no gold detected.
6	Golden King Claim	Discontinuous fracture zones strike N. 30° - 40° E. and dip 56° - 68° SE. in porphyritic granodiorite cut by rhyolite and dacite dikes. Very minor pyrite and boxwork in quartz vein material noted on dump.	Four pits.	Three chip samples and three grab samples: two grab samples of quartz vein material yielded 0.01 oz/ton gold; two chip and two grab samples of quartz and altered dike rock contained 0.1 and 0.2 oz/ton silver, respectively.
7	Prospect	Three discontinuous shear zones in granodiorite host rock with the following measurements: 70 ft long and 6 ft thick, strike N. 10° W., dip 70° E.; 27 ft long and 3 ft thick, strike N. 80° W., dip 87° N.; and 45 ft long and 3.5 ft thick, strike N. 60° W., dip 85° SW. Disseminated pyrite and boxwork occur sporadically in siliceously altered dacite porphyry in contact with granodiorite.	One adit 30 ft long, one pit 10 ft long, and one cut 18 ft long.	Three chip samples from shear zones: two contained 0.678 and 0.05 oz/ton gold; two contained 0.2 and 1.6 oz/ton silver.

Table 8.--Mines, prospects, and claims within and adjacent to the Upper Middle Fork--Continued

Map no.	Name	Geology	Workings and production	Sample and resource data
8	Prospect	Shear zone strikes N. 5° W. and dips 60° E. in granodiorite, is approximately 20 ft long and 2.5 ft thick and contains visible pyrite, arsenopyrite, sphalerite, and galena.	One adit 22 ft long.	One chip sample: 0.133 oz/ton gold and 1.3 oz/ton silver.
9	Prospect	Quartz float contains less than 1% pyrite, minor galena, and arsenopyrite. Host rock in the area is silicified porphyritic dacite.	One caved adit and a trench 30 ft long.	One grab sample of quartz: 0.046 oz/ton gold and 0.6 oz/ton silver.
10	Snowslide Claim	Two- to 4-ft-thick quartz-filled fissure vein strikes N. 55° W. and dips 60° NE. for about 110 ft in granodiorite. Moderately disseminated to massive pyrite sporadically occurs in veinlets or pods within the fissure vein.	One adit 5 ft long, one caved adit, one 15-ft-deep shaft, and one small cut.	Two chip samples of quartz: 0.160 and 0.028 oz/ton gold; one contained 0.2 oz/ton silver. One grab sample of massive pyrite: 0.748 oz/ton gold, 1.8 oz/ton silver, 1.48% lead, and 0.76% zinc.
11	Old Soldier No. 1 Claim	Two- to 7-ft-thick discontinuous shear zone containing chloritic, argillic, and silicic alteration, strikes N. 40° - 50° W. and dips 80° NE. to vertical. Host rock is gneissic roof pendant intruded by granodiorite and dacite.	Three caved adits totalling approximately 45 ft, and five pits.	Nine chip samples and one grab sample of shear zone material: three chip samples yielded 0.06, 0.16, and 0.56 oz/ton gold, and two had a trace gold; three contained 0.5, 1.2, and 9.7 oz/ton silver.
12	Old Soldier No. 2 Claim	Three to 6-ft-thick discontinuous, hydrothermally altered shear zone strikes N. 10° - 20° W. and dips 60° - 75° for 40 and 50 ft in granodiorite. Chloritic, argillic, and silicic alteration present.	Two adits, 4 ft and 12 ft long.	Three chip samples: two samples from shear zone yielded 0.092 and 0.27 oz/ton gold, and 0.6 and 0.7 oz/ton silver.
13	Josephus Silver* Claim	A siliceously altered zone strikes N. 50° - 55° W. and dips 60° NE. in gneissic roof pendant intruded by granodiorite. The zone is partly exposed for 350 ft.	Two caved adits, one shallow shaft, and seven pits.	Three chip samples and four grab samples: one chip sample from altered zone yielded 0.01 oz/ton gold and 1.2 oz/ton silver; one grab sample of altered gniess yielded 0.02 oz/ton gold and 2.1 oz/ton silver.
14	Float Creek Mine*	Discontinuous quartz veinlets and pods in hydrothermally altered granodiorite contain minor pyrite and galena.	One caved adit and 26 pits.	One chip sample and seven grab samples of altered granodiorite with quartz: five grab samples yielded gold values ranging from 0.012 to 0.086 oz/ton; six grab samples yielded silver values from 0.2 to 8.4 oz/ton.
15	Prospect.	One- to 1.5-ft-thick shear zone with quartz strikes N. 50° E. and dips 67° SE. in silicified granodiorite cut by dacite dike swarm. Minor amounts of sulfide and copper minerals occur in the shear zone.	One caved adit and one adit 80 ft long.	Four chip samples across shear zone: three yielded 0.2, 1.0, and 1.4 oz/ton silver; three contained 0.042, 0.093, and 0.185% copper. One grab sample of quartz vein material: 0.4 oz/ton silver; no gold detected.

Table 8.--Mines, prospects, and claims within and adjacent to the Upper Middle Fork--Continued

Map no.	Name	Geology	Workings and production	Sample and resource data
16	Prospect	Contact between granodiorite and Tertiary rhyolite dike strikes N. 65° E. and dips 75° SE. Rocks are moderately silicified and iron-oxide-stained.	One caved adit, one shallow shaft, and one pit.	Two chip samples and one grab sample of siliceously altered host and dike rock: one chip sample yielded 0.1 oz/ton silver; no gold detected.
17	Prospect	Northwest-trending rhyolite and dacite dikes cut granodiorite host rock. Minor quantities of pyrite, hematite, malachite, and vuggy quartz occur in argillically altered fracture zones.	One shallow shaft and 29 pits.	Six chip samples and two grab samples: three chip samples of siliceously altered host and dike rock yielded 0.2, 0.3, and 0.4 oz/ton silver, and one grab sample of altered granodiorite contained 1.9 oz/ton silver; no gold detected.
18	Prospect	A 6-ft-thick argillized zone strikes N. 5° E. and dips 89° NW. in granodiorite. Quartz veinlets present in zone.	One pit.	One chip sample: no gold or silver detected.
19	Robin Claim	Vertical joints strike due E. in siliceously altered granodiorite and contain quartz-filled vugs with minor pyrite and galena.	One small pit.	One chip sample and one grab sample: both yielded 0.01 oz/ton gold and 0.5 and 0.7 oz/ton silver, respectively.
20	KG Claim	One hundred ft-long, intermittently exposed contact between siliceously altered granodiorite and dacite dike strikes N. 30° E. and dips 70° SE. Visible pyrite, arsenopyrite, galena, malachite, and azurite occur sporadically in the contact zone and on fracture and joint surfaces.	Three small pits.	Three grab samples and one chip sample of siliceously altered host rock: one grab yielded 0.01 oz/ton gold, three grab samples contained 2.0, 2.1, and 8.9 oz/ton silver, and one chip sample had 1.0 oz/ton silver. All contained 0.094% to 0.244% copper.
21	Prospect*	Gouge zone 2.9 ft thick strikes N. 15° E. and dips 87° SE. in siliceously altered porphyritic granodiorite.	Two caved adits.	One chip sample: 0.4 oz/ton silver; no gold detected.
22	Portland Mine	Discontinuous, quartz-filled fissure veins strike northwesterly and dip near vertically in granodiorite. Silicification and argillic alteration are common around the veins. Minor amounts of pyrite, boxwork and drusy quartz are sporadically present.	One adit 20 ft long, two shafts approximately 8 ft deep, and 12 pits.	Eleven chip samples and one grab sample: one chip sample across a shear zone yielded 0.022 oz/ton gold and 1.0 oz/ton silver; the grab sample of siliceously altered host rock with pyrite yielded 2.5 oz/ton silver.
23	Prospect	A discontinuous 2-ft-thick limonite-stained quartz vein strikes N. 22° E. and dips 70° NW. in siliceous granodiorite.	One small shaft.	One chip sample: no gold or silver detected.
24	Prospect	A 25-ft-long, 3- to 4-ft-thick quartz-filled fissure vein strikes N. 35° E. and dips 78° NW. in granodiorite.	Two pits.	One chip sample: 0.3 oz/ton silver; no gold detected.

Table 8.--Mines, prospects, and claims within and adjacent to the Upper Middle Fork--Continued

Map no.	Name	Geology	Workings and production	Sample and resource data
25	Prospect	Discontinuous 3.5-ft-thick alteration zone strikes N. 80° E., dips 70° NW., and contains a 0.5-in.-thick quartz vein in iron-oxide-stained granodiorite.	One small pit.	One chip sample: no gold or silver detected.
26	Prospect	Discontinuous 6-ft-thick siliceously altered zone in granodiorite, strikes N. 45° E., dips 82° SE., and contains quartz veinlets and iron-oxide stains. Galena and hematite are visible in high-grade dump material.	One caved adit 25 ft long, and one pit.	One chip sample and one grab sample: the grab sample of dump material yielded 1.4 oz/ton silver and 0.09% copper; no gold detected in either sample.
27	Prospect	One- to 5-ft-thick quartz-filled fissure vein strikes N. 60° E. and dips 56° - 77° E. in granodiorite. The fissure vein is exposed for about 750 ft along strike and contains visible chalcopyrite, malachite, and azurite.	Three small pits.	Two chip samples: 0.5 and 0.3 oz/ton silver, and 0.02 and 0.03% copper; no gold detected.
28	Prospect	Quartz-filled fissure vein up to 1-ft-thick strikes N. 65° E. and dips 74° NW. for 23 ft in granodiorite. Pyrite, malachite, azurite, and hematite are in the vein.	Three pits.	One chip sample and one grab sample of quartz vein material: both contained 0.4 oz/ton silver, and the chip sample yielded 0.06% copper; no gold detected in either sample.
29	Prospect*	A 1-ft- thick shear zone strikes N. 65° E. and dips 74° SE. for 17 ft in granodiorite with minor iron-oxide stains and euhedral quartz. There are few outcrops in or around the pits.	Nine pits ranging from 6 to 70 ft long and 2 to 5 ft deep.	Two grab samples of slightly altered quartz: one contained 0.5 oz/ton silver; no gold detected in either sample.
30	Prospect*	Discontinuous 4.5-ft-thick shear zone strikes N. 75° E., dips 82° NW. in iron-oxide-stained granodiorite.	One small pit.	One chip sample: no gold or silver.
31	Prospect*	Discontinuous 2.6-ft-thick altered contact zone in a roof pendant comprised of quartzite and schist strikes N. 55° E. and dips 75° SE.	Five pits.	One chip sample across contact zone: no gold or silver.

MINERAL APPRAISAL OF THE SALMON RIVER AND COVE MOUNTAIN UNITS, IDAHO COUNTY, IDAHO

by

Leon E. Esparza

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Figure 21. The Salmon River and Cove Mountain units, Idaho County, Idaho 144

TABLE

Table 9. Claims and mineralized sites within the Salmon River and Cove Mountain units, Idaho County, Idaho 147

INTRODUCTION

Location and Access

The Salmon River and Cove Mountain units of the Frank Church-River of No Return Wilderness are about 35 miles southeast of Grangeville, Idaho (fig. 21). The Salmon River unit encompasses an area of about 37,000 acres. Forest Service roads provide access to the northwestern and southern boundaries. The Cove Mountain unit includes an area of about 3,600 acres and can be reached from the north by Forest Service roads from Dixie, Idaho. Several local outfitters and resorts operate jet boats on intermittent schedules on the river. Pack trails within the units are few and generally inadequately maintained.

Setting

Both the Salmon River and Cove Mountain units have steep, rugged topography with deeply incised drainages. Elevations in the Salmon River unit range from 6,902 ft at Mill Point, southwest of MacKay Bar, to 2,000 ft along the Salmon River near the mouth of Wind River on the northwestern boundary. Elevations in the Cove Mountain unit range from 6,080 ft at Cove Mountain to 2,160 ft at the southernmost point on the Salmon River. Vegetation in both units consists of ponderosa pine with a grass understory, and Douglas fir.

Climate ranges from moist and cool in subalpine areas to warm and dry along the Salmon River. Mean annual precipitation ranges from 18 in. on the Salmon River to 60 in. in the subalpine areas. Winter snow depths of about 15 ft are normal at elevations about 7,000 ft or more; only a few inches accumulate at the lower elevations. Summer temperatures range from about 110°F along the Salmon River to about 80°F at higher elevations. The annual mean temperature at Grangeville is 46.5°F (National Oceanic and Atmospheric Administration, 1974).

Previous Investigations

Previous studies specifically concerning the study areas are nonexistent. The geology, mineral deposits, mining methods, and history of mining districts in or adjacent to the units are discussed by Thomson and Ballard, (1924), Thompson (1924), Shenon and Reed (1934), Lorain (1938), Lorain and Metzger (1938), Capps (1939, 1940), and Reed (1937, 1939, and 1942). Mineral resource investigations of adjacent wilderness and areas previously referred to as primitive areas have been done by Weis and others (1972), Cater and others (1973), and Esparza and others (1984). Results of the U.S. Department of Energy National Uranium Resource Evaluation (NURE) have been reported by Broxton and Beyth (1980), EG & G geoMetrics (1980), and U.S. Department of Energy (1982b).

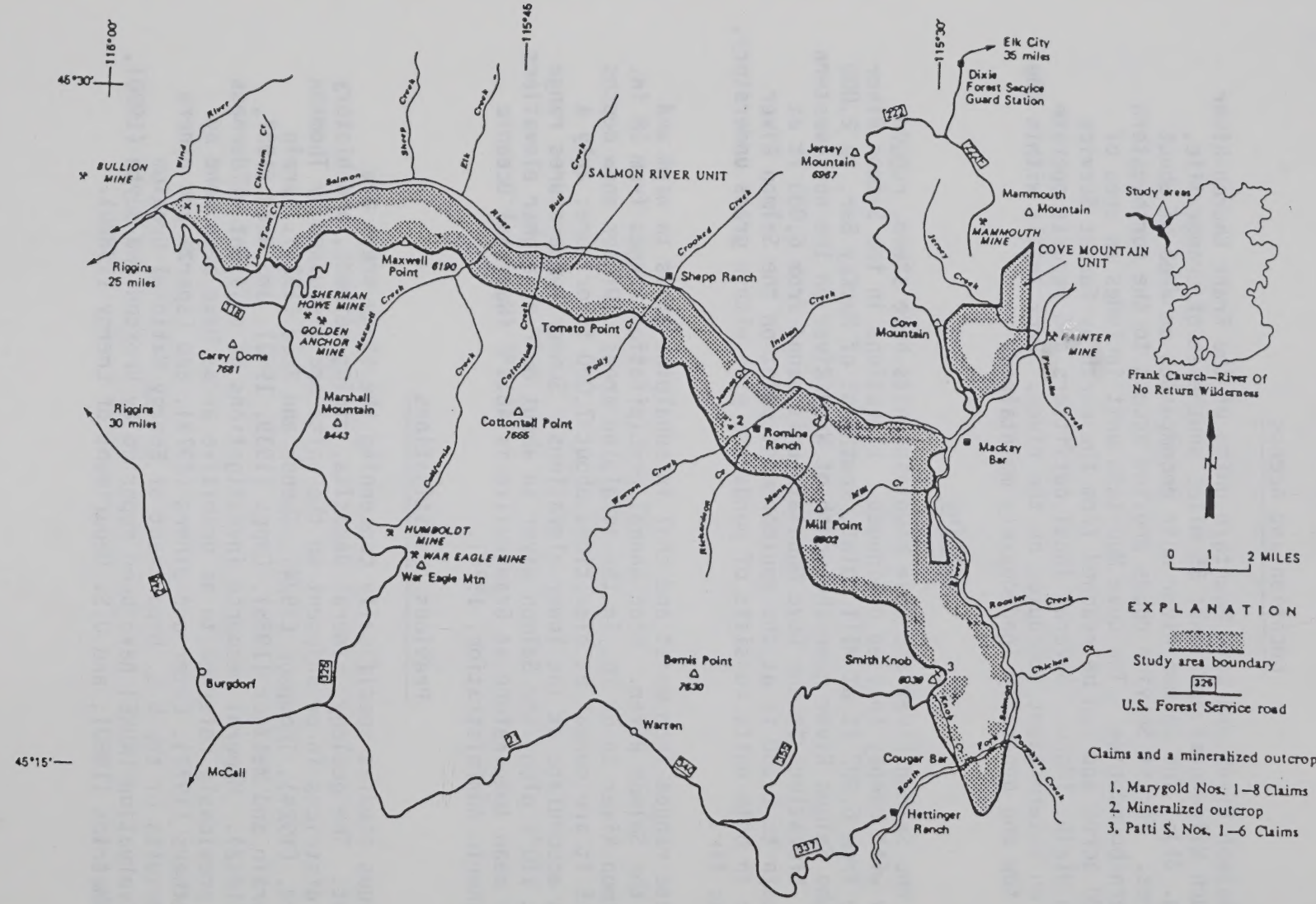

FIGURE 21.—The Salmon River and Cove Mountain units, Idaho County, Idaho

MINERAL APPRAISAL

Mining History

The Salmon River unit encompasses the northern portions of the Warren and Marshall Lake mining districts (fig. 3). James Warren and a group of prospectors discovered placer gold in Warren in 1862. Placer deposits also were found about the same time in what later became known as the Marshall Lake district, northwest of Warren. Lode gold and silver deposits have also been mined from these districts, but production has been substantially from placer gold deposits. Total recorded production from the Warren and Marshall Lake districts is as follows: placer gold, 906,000 oz; lode gold and silver, 58,234 and 123,337 oz, respectively; copper, lead and zinc, 12,497., 26,585, and 294 lb, respectively (U.S. Bureau of Mines records; Koschmann and Bergendahl, 1968).

The Cove Mountain unit is within the southeastern portion of the Dixie mining district where placer gold deposits were discovered in August 1864 (Capps, 1939, p. 3). Early development of lode deposits was hampered by the remoteness of the area (Thomson and Ballard, 1924, p. 73; Koschmann and Bergendahl, 1968, p. 131). Production from the Dixie district includes 40,000 to 75,000 oz (estimated) placer gold; 2,408 oz lode gold; 1,534 oz silver; and copper and lead totaling 927 and 2,483 lb, respectively (U.S. Bureau of Mines records; Koschmann and Bergendahl, 1968).

Geologic Setting

A geologic map compiled by Mitchell and Bennett (1979) shows the predominant rock types along the Salmon River are granodiorite, quartz monzonite, quartz diorite, trondhjemite, migmatite, and alaskite of the Idaho batholith with various amounts of metamorphic rock inclusions. Also present along the western portion is biotite gneiss which they think may be Precambrian age and equivalent to or part of the Belt Supergroup.

Faults trend northeasterly; however, their type is undefined by Mitchell and Bennett (1979). Onasch (1979) shows extensive thrust faults west of the study areas. Capps (1939) reports block faults in the Dixie mining district. North-trending folds are shown by Onasch (1979) in rocks of the Riggins Group, and by Shenon and Reed (1934) in the Buffalo Hump mining district north of the study areas.

In the deposits near the study areas, gold and silver commonly occur in quartz veins filling shear zones and fractures, or disseminated in granodiorite or quartz monzonite. Alteration at some of the deposits includes subtle iron oxidation, silicification, and sericitization. In general, veins in the Dixie mining district strike northwest and seem to be arranged en echelon in northeast zones (Capps, 1939, p. 26). Veins in the Florence and Warren mining districts generally strike eastward and dip steeply south (Reed, 1937, p. 36; 1939, p. 28). Mineralized solutions generally appear to have been controlled by joints and faults. In contrast, the only known lode occurrence within the study areas, on the Marygold claims, contains tungsten associated with a schist-granite contact. Numerous alluvial deposits occur along rivers and creeks in and near the study areas; some contain gold.

Claims and Mineralized Areas

A search of the records did not reveal any active mineral leases. Of fourteen lode claims within the study areas, only the Marygold Nos. 1-8 (Wilderness Group) were known to be active in 1983. Other mining activity in the study area is unknown, with the exception of the required annual assessment work. Lode mineral resources were not recognized at any of the sites visited. Table 9 summarizes the lode claims and a mineralized outcrop within the Salmon River unit; no claims or mineralized areas were found in the Cove Mountain unit. Activity in nearby mines is limited to small operations that employ less than 10 people. Wages paid by these operations, however, provide a significant contribution to the local economy.

ASSESSMENT OF MINERAL RESOURCES

Lode occurrences of tungsten, copper, and molybdenum are recognized in the Salmon River unit; resources are not apparent. In general, the geology of deposits outside the study areas indicate extensions of mineralized shear zones are not likely to be found within the Wilderness.

Sand and gravel deposits in the units are suitable for construction uses. However, they are not considered as resources because transportation costs to major markets would be several times the value of these materials.

Table 9.--Claims and mineralized sites within the Salmon River and Cove Mountain units

Map no.	Name	Summary	Workings	Sample data
1	Marygold Nos. 1-8 Claims (Wilderness Group)	Biotite schist with pyrite-bearing quartz veinlets, and actinolite-tremolite schist with pyrite-filled veinlets in pendants in quartz-rich granite; both schists have 0.6 to 4.0 ft pods of disseminated scheelite. The schists pinch and swell and can be traced on the surface for about 400 ft (Kiilsgaard, 1954). The Wilderness Group was located by Jack Grush in 1981.	One adit 55 ft long.	Six chip samples of biotite schist: tungsten content in five samples ranged from 0.001% to 0.30% and averaged 0.12% tungsten trioxide (WO_3); no WO_3 was detected in one sample. One sample taken across the adit face also had 0.02% copper and 0.011% MoS_2 (molybdenum disulfide).
2	Mineralized outcrop	A lenticular, 1-ft-thick quartz vein strikes N. 55° W. and can be traced 60 ft in a granodiorite country rock. The vein contains pyrite, arsenopyrite, chlorite, and sericite.	None.	One select sample of quartz vein material: 0.20 oz/ton gold, 0.0014% molybdenum, 0.02% zinc, and 0.014% lead.
3	Patti S. Nos. 1-6 Claims	Medium- to coarse-grained biotite quartz monzonite with biotite schist xenoliths crops out on Smith Knob. Iron oxides occur around xenolith boundaries. These claims were located by Otis Schoolcraft in March 1980.	None.	One grab sample of quartz monzonite: no gold or silver detected.

MINERAL APPRAISAL OF THE MAGRUDER-BLUE JOINT UNIT, IDAHO AND LEMHI COUNTIES, IDAHO

by

Leon E. Esparza

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Figure 22. The Magruder-Blue Joint unit, Idaho and Lemhi Counties, Idaho 154

INTRODUCTION

Location and Access

The Magruder-Blue Joint unit is in northeastern Idaho adjacent to the Montana border about 30 miles southwest of Darby, Montana, and encompasses approximately 85,000 acres. The two parts of the unit are joined by the Idaho-Lemhi county line (fig. 22). Trails in the unit, particularly in the Magruder area, were in very poor condition in 1983 and many were not sufficiently marked, making their use difficult and in some cases hazardous. The Magruder area can be reached by paved and graveled roads from Darby, Montana. The Blue Joint area can be reached from the West Fork ranger station in Ravalli County, Montana.

Setting

The topography in the unit is characterized by steep to moderately steep, mountainous terrain with a dendritic drainage pattern. Prominent physiographic features include the Selway River, which divides the western portion of the Magruder area. The highest peak within the unit is Blue Joint Mountain at an elevation of 8,681 ft and the lowest point is near Magruder Crossing at 3,880 ft. Vegetation in both areas consists of Douglas fir, ponderosa pine, grass and forb.

Previous Investigations

Geologic mapping has been conducted by Lindgren (1904), and Lund and others (1983a). A detailed study of Eocene volcanic rocks was done by Holloway (1980) and of the Painted Rocks pluton by Hall (1980). Geochemical surveys of the unit have been done by Millard and others (1982), Arbogast and others (1982), and Mosier and others (1982a, 1982b). The Elk City 1° X 2° quadrangle, in which the unit is located, was surveyed for uranium potential during the National Uranium Resource Evaluation (NURE) program. The program included a hydrogeochemical and stream sediment sampling study by Broxton and Beyth (1980) and an aerial radiometric survey by EG & G geoMetrics (1980). A residual intensity magnetic anomaly contour map has also been published by the U.S. Department of Energy (1982b). An evaluation of potential uranium resources was done by Leinart and Salisbury (1982). Mineral resources of the Blue Joint Wilderness, Ravalli County, Montana and the Blue Joint Roadless area, Lemhi County, Idaho have been reported by Lund and others (1983a, 1983b).

Mitchell and others (1981b) do not show any mines or prospects within the unit and only one mine (the Blue Plate Mine) near the southeast border of the Blue Joint area (p. 33).

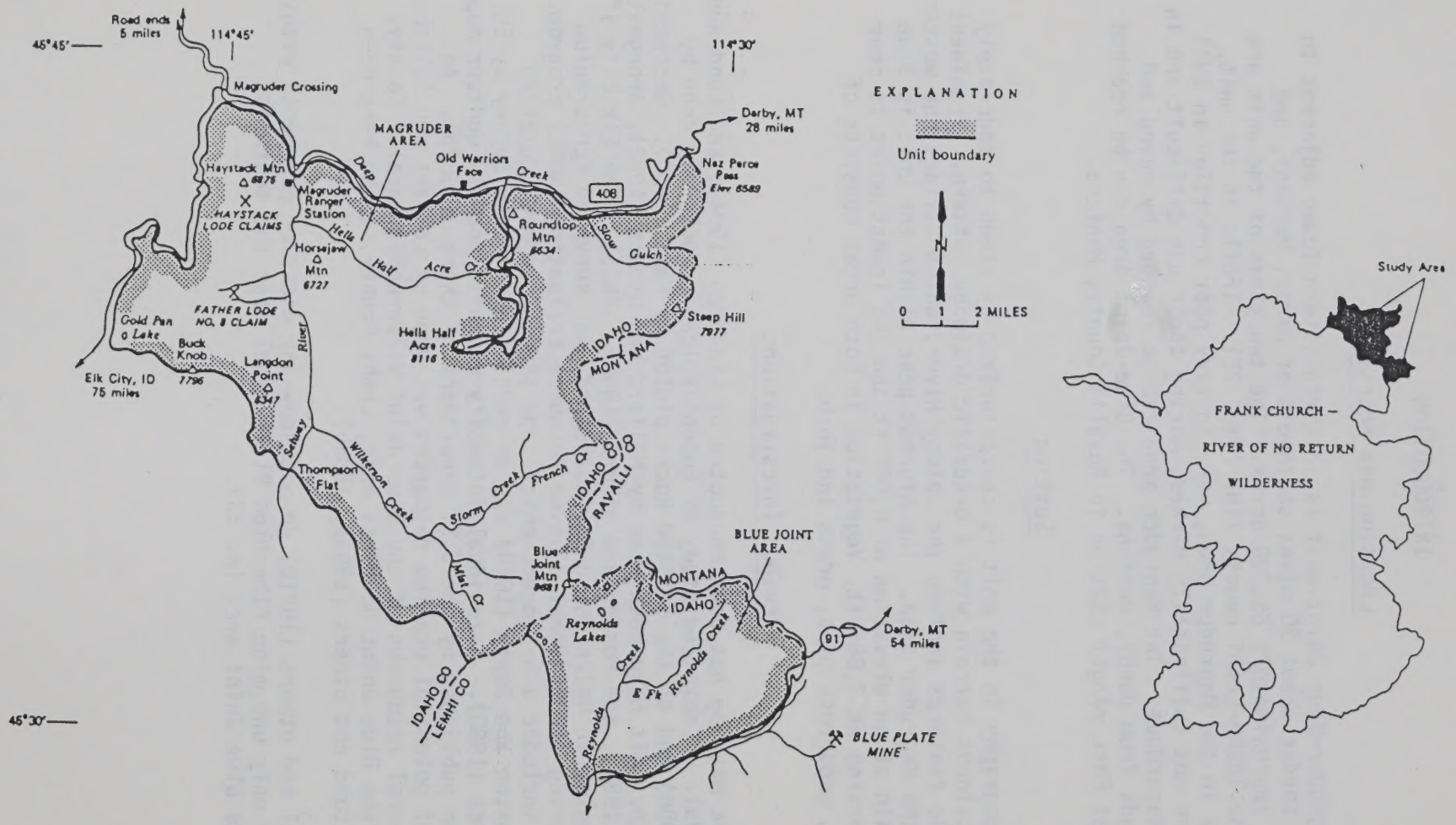

FIGURE 22.–The Magruder-Blue Joint unit, Idaho and Lemhi Counties, Idaho

MINERAL APPRAISAL

Mining History

Within and adjacent to the unit, 21 placer and four lode claims have been recorded, the earliest of which were recorded by R. Millam and A. T. Newell in September 1915. As of November 1983, no active claims within the unit were recorded with the Bureau of Land Management. The nearest mining activity occurred in the Overwich-Hughes Creek and the Mineral Point districts, about 20 miles east of the study area in Ravalli County, Montana. Earliest recorded production occurred in 1904 in the Overwich-Hughes Creek district (Sahinen, 1957). U.S. Bureau of Mines records for the period 1924-1964 indicate 357 oz of gold, 84 oz of silver, and 396 lb of copper produced from lodes, and 4,402 oz of gold and 278 oz of silver from placers in the Overwich-Hughes Creek district; 18 oz of gold, 87 oz of silver, and 900 lb of copper were produced from lodes only in the Mineral Point district.

Geologic Setting

The primary rock types are quartz monzonite and granite of the Painted Rocks pluton of Eocene age. Outcrops of gneiss, schist, quartzite and amphibolite of Precambrian Y age form roof pendants in several locations in the central and eastern portions of the Magruder area.

Lineaments in the study area trend predominantly north; however, a few trend northwest and northeast. Foliation is also primarily oriented northerly, but there is also an easterly component.

Mining Claims

The Haystack Lode Claims south of Haystack Mountain were located in August 1943 by C. E. Stinebaugh. Field reconnaissance in the vicinity of the recorded location of the claims did not reveal workings. One grab sample showed 0.005% molybdenum, 0.009% zinc, 0.015% fluorine and 0.044% bismuth. The rock type in the general vicinity is granite and quartz monzonite of the Painted Rocks pluton.

The Father Lode No. 8 Claim near the West Fork of Teepee Creek was located in May 1964 by Clyde D. Painter. Reconnaissance in the vicinity of the recorded location of the claims did not reveal workings. One grab sample of quartz monzonite showed only 0.001% zinc and 0.005% fluorine.

ASSESSMENT OF MINERAL RESOURCES

The paucity of mining claims, mine workings or other evidence of mineral exploration activity in the Magruder-Blue Joint unit indicates a lack of historic interest in the area with respect to mineral resources.

Two rock units identified as potential hosts for mineral resources in the Blue Joint RARE II and Wilderness study areas by Lund (1983, personal communication) and Felix Mutschler (unpublished map) crop out in the Magruder area. Lund and others (1983b) report a moderate potential for molybdenum stockwork deposits and high potential for gold and silver in volcanic rocks of Tertiary age. Moderate potential for molybdenum stockwork deposits also is shown for Proterozoic quartz schist. These potential resource areas are east of Steep Hill, adjacent to the eastern boundary of the Magruder area. Evidence of workings or mining claims in the vicinity of Steep Hill were not found.

A moderate potential for uranium is reported by Lund and others (1983b) in the vicinity of Middle Fork Reynolds Creek and Horse Creek in the Blue Joint area. The potential is related to quartz monzonite and granite in the Painted Rock Pluton of Tertiary age. However, increased uranium content is a common phenomenon in granitic rocks of Tertiary age (Bennett, 1980). Radiometric data published by EG & G geoMetrics (1980a) show the radioactivity to be pervasive in the Blue Joint area. Therefore, the pluton is probably a source of uranium, but not necessarily a host for deposits.

MINERAL APPRAISAL OF THE MIDDLE BARGAMIN CREEK AND BIG MALLARD CREEK UNITS, IDAHO COUNTY, IDAHO

by

Leon E. Esparza

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Figure 23. The Middle Bargamin Creek and Big Mallard Creek units, Idaho County, Idaho 162

INTRODUCTION

Location and Access

The Middle Bargamin Creek and Big Mallard Creek units of the Frank Church-River of No Return Wilderness are about 25 miles southeast of Elk City, Idaho (fig. 23). The Middle Bargamin unit can also be reached by traveling about 95 miles west from Darby, Montana. Pack trails within the study areas are few, but generally well maintained.

The Middle Bargamin Creek unit includes an area of about 12,900 acres. It is bounded on the north and west by Forest Service Road 468, on the south by a predominantly east-trending ridge line that passes through Grouse Creek Point, and on the east by Road 468 and a foot trail leading to Trilby Lakes. The Big Mallard Creek unit, an area of about 980 acres, is bounded on the north and northwest by Forest Service Road 421. The southern boundary is about 1 mile east of Forest Service Road 421.

Setting

The Middle Bargamin Creek unit has moderately steep terrain and is dissected by numerous tributaries of Bargamin Creek, the principal physiographic feature within the area. Elevations range from 7,920 ft on the ridge line north of Trilby Lakes to 4,640 ft on Bargamin Creek at the southern boundary of the study area. Vegetation consists of ponderosa pine, Douglas fir, lodgepole pine, and an understory of grass and forb.

Elevations in the Big Mallard Creek unit range from about 5,200 ft on the northern boundary, just east of Forest Service Road 421, to about 3,600 ft on Big Mallard Creek near the southern boundary. Big Mallard Creek, the most prominant physiographic feature, flows southwest into the Salmon River. The topography is very steep and rugged. Vegetation consists of ponderosa pine, Douglas fir, and an understory of grass and forb.

Previous Investigations

Geologic mapping within and near the study areas has been compiled by Greenwood and Morrison (1973) and Mitchell and Bennett (1979). Mitchell and others (1981b) show several mineral occurrences near the study areas. Earlier regional geologic mapping was done by Lindgren (1904).

Uranium resources of the Elk City 1° X 2° quadrangle were evaluated during the National Uranium Resource Evaluation (NURE) program. Results of the several methods used to evaluate the potential for these resources are reported by Leinart and Salisbury (1982), Broxton and Beyth (1980), EG & G geoMetrics (1980), and U.S. Department of Energy (1982b).

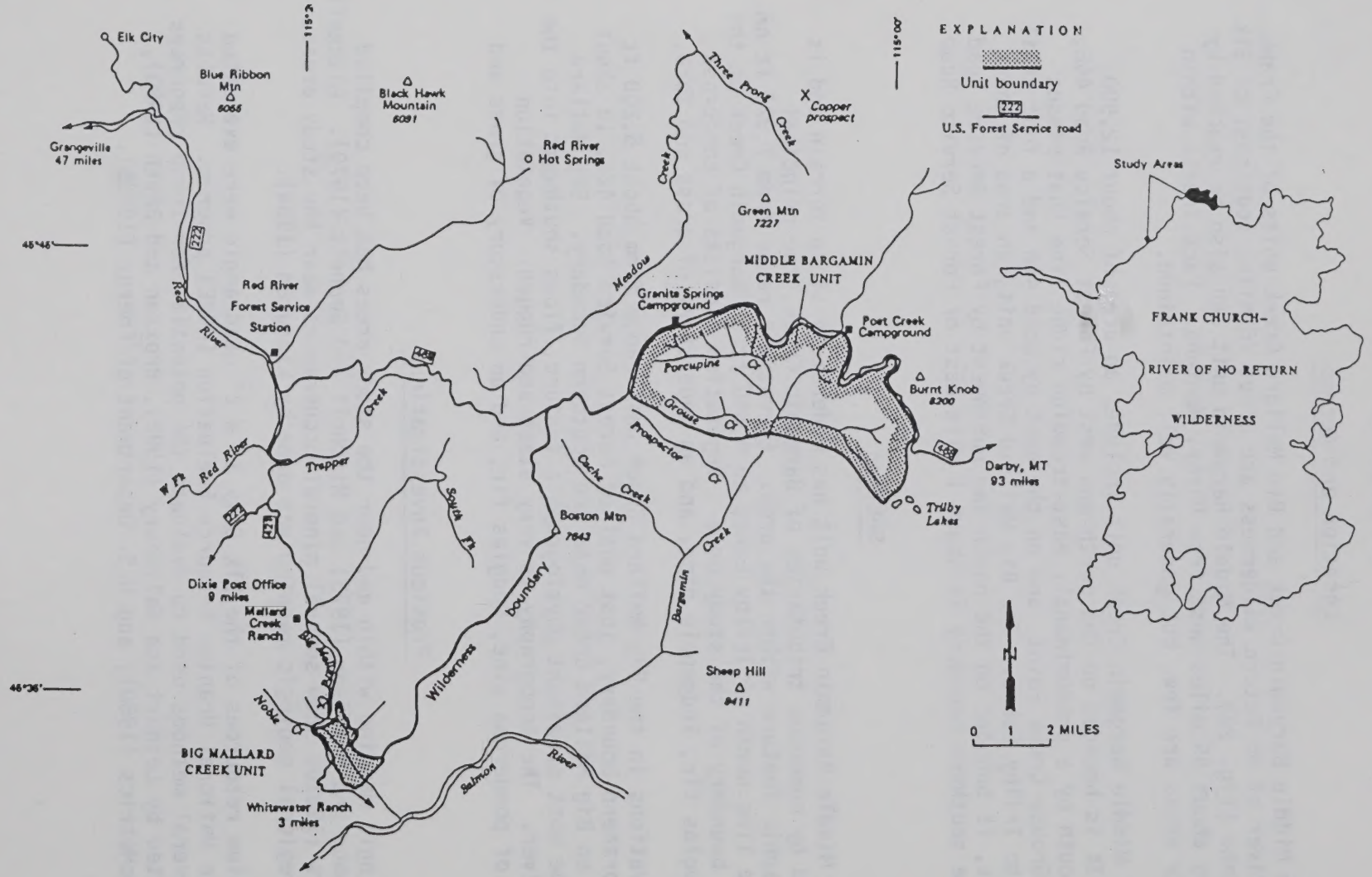

FIGURE 23.—The Middle Bargamin Creek and Big Mallard Creek units, Idaho County, Idaho

MINERAL APPRAISAL

Mining History

Part of the Middle Bargamin Creek unit lies within the southern portion of the Green Mountain mining district; the Big Mallard Creek unit lies between the Dixie mining district to the west and the Chamberlain Basin district to the south (fig. 3). History of some of the region's districts is discussed by Shenon and Reed (1934) and Capps (1939). Northwest of the Middle Bargamin Creek unit, Campbell (1929, p. 154; 1930, p. 158) reported activity by Bunker Hill and Sullivan Mining and Concentrating Company and others on a copper-silver prospect on Green Mountain near the headwaters of Three Prong Creek (fig. 23). Idaho County records indicate Bear Creek Mining Company claimed this prospect in 1966.

Bureau of Land Management mining claim records did not show any active claims in either of the units as of June 1983. Idaho County courthouse records did not reveal any historic mining claims.

Geologic Setting

The Big Mallard Creek unit is underlain by biotite gneiss with thin interlayers of quartzite and mica schist heavily injected by sills, dikes, and quartzo-feldspathic stringers (Greenwood and Morrison, 1973, Plate 1). According to their studies, this unit is possibly equivalent to a nearby pelitic schist which they tentatively correlate with the Prichard Formation of the Precambrian Belt Supergroup.

Cretaceous quartz monzonite and a foliated porphyritic quartz monzonite of the Idaho batholith underlie most of the Middle Bargamin Creek unit (Greenwood and Morrison, 1973, Plate 1). A lithostratigraphic unit Greenwood and Morrison (1973) tentatively correlate with the Wallace Formation of the Belt Supergroup crops out along the southeastern part of the study area. This unit is composed of quartz, biotite, plagioclase gneiss and schist and biotite-plagioclase quartzite which may be intergradational, and contains sporadic occurrences of kyanite and sillimanite. Coarsely-banded, biotite augen gneiss with feldspar porphyroblasts, of possible Precambrian age, crops out in the far northwestern portion of the study area and is in contact with the same biotite gneiss which underlies the Big Mallard Creek unit. Greenwood and Morrison (1973, Plate 1) show a copper occurrence (fig. 23) in the biotite augen gneiss along Meadow Creek just north of the Middle Bargamin Creek unit.

ASSESSMENT OF MINERAL RESOURCES

No mineral resources were identified in the Middle Bargamin Creek and Big Mallard Creek units of the Frank Church-River of No Return Wilderness. Although there are occurrences of copper, cobalt, and nickel-bearing minerals nearby, extensions of mineralized zones into the study areas are not apparent. No occurrences of kyanite or sillimanite were found in the Middle Bargamin Creek unit.

A grab sample of alluvium, collected from a tributary stream south of Poet Creek campground (fig. 23), contained only a trace of gold; no gold was detected in eight other grab samples.

APPRAISAL OF PLACER DEPOSITS IN PART OF THE FRANK CHURCH-RIVER OF NO RETURN WILDERNESS, IDAHO

by

Michael C. Horn, Andrew M. Leszcykowski,
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INTRODUCTION

Placers are deposits of sand and gravel containing a valuable heavy mineral which has accumulated through weathering and concentration by mechanical processes (Wells, 1973, p. 3). Numerous placer deposits occurring along rivers and creeks in the Wilderness include (1) river level bars that are reworked each year due to the annual fluctuations of the river level; (2) bars that are slightly above the level of the normal flood stage but are reworked during the years when the river has an abnormally high flood stage; and (3) perched bars (remnants of ancient alluvial deposits) that are significantly above the river level, at any flood stage, and are not reworked.

In addition to provisions of the Wilderness Act (Public Law 88-577, Sept. 3, 1964) which specifically prohibit the use of motor vehicles, motorized equipment, landing of aircraft, or any other form of mechanical transport [Sec. 4(c)] and, subject to prior valid rights, withdrawal of all lands from appropriation under mining laws [Sec. 4(d)(3)], the Central Idaho Wilderness Act (Public Law 96-312, July 23, 1980] and the Wild and Scenic Rivers Act [sec. 9(a), of amendment to the Act] specifically prohibit dredge and placer mining in any form within the Middle Fork Salmon River and its tributary streams in their entirety.

Methods of Evaluation

Prior to field examination, courthouse records, mining literature, and aerial photographs were used to identify areas where placer deposits were known or suspected to occur. Three areas (stippled on fig. 24) of major placer gold concentrations not previously studied during wilderness projects are: (1) Loon Creek from the mouth of Canyon Creek north to the mouth of Shell Creek; (2) Salmon River from the mouth of Fivemile Creek, near the Painter Mine, west to the mouth of Wind River; and (3) Middle Fork Salmon River from the mouth of Deer Horn Creek north to Sheepeater Bar. Placer deposits on the South Fork Salmon River were also identified.

Evaluation of placer gold deposits was accomplished during the 1981, 1982, and 1983 summer seasons. Grab samples of alluvium from numerous sites were concentrated by hand panning, and bars with the highest gold content were designated for additional sampling. Hand-dug trenches were cut through the benches which had been cleaned of surficial debris to expose undisturbed gravel. Channel samples equal to 1 ft^3 of sample per vertical foot were then removed. Each sample was concentrated using a sluice box, and further reduced in volume by hand panning. Some channel samples consisted of 1 ft^3 of gravel collected per three vertical feet of trench; these samples were concentrated by hand panning.

46°00'
116°00'
115°00'
114°00'
Magruder-Blue Joint unit
Cove Mountain unit
Salmon River unit
Salmon River
South Fk Salmon River
Salmon River
Salmon River
Salmon River
FRANK CHURCH–
RIVER OF NO RETURN
WILDERNESS
Yellowjacket unit
EXPLANATION
Areas of placer gold accumulations evaluated during this study
Areas of black sand placers evaluated during this study

FIGURE 24.—Areas of gold and black sand placers in the Frank Church-River of No Return Wilderness

Estimation of areal extent of the gravel bars was based on field mapping and aerial photographs. The volume of gravel in a bar was computed from the estimated area and average vertical thickness as measured in sample trenches. Single-channel seismic surveys were run parallel and perpendicular to river flow to help determine depth to bedrock and to establish consistent gravel thickness where possible.

Sample concentrates were sent to the U.S. Bureau of Mines Western Field Operations Center where each was checked for fluorescence and radioactivity, and the magnetic fraction and any gold was removed and weighed. The gold was weighed in milligrams and multiplied by 0.00003215 to obtain the number of troy ounces. Average content per cubic yard was calculated by dividing the gold content of all samples taken on a bar by the total volume of all the samples. Two hundred ninety-nine grab and channel samples of alluvium were collected during this study.

Because of legislative restrictions and in accomodation of archeological considerations of the U.S. Forest Service, only active cutbanks or gravel at the margin of recent flood levels were selected as sample sites. The interiors of the bars and bench placers were not sampled. Additionally, poor access necessitated the use of small, highly-portable equipment not amenable to bulk sampling. Thus, the data obtained from field sampling is of a reconnaissance nature and is intended to indicate areas where additional sampling may be warranted. Resources estimated from these data are classified as inferred. The placer gold deposits are discussed in order of their apparent importance.

PLACER GOLD DEPOSITS, OCCURRENCES, AND CLAIMS

Loon Creek-Warm Spring Creek Unit

Placer deposits occur along the middle reaches of Loon Creek from Canyon Creek to Shell Creek (fig. 25). The area is accessible by road up the Yankee Fork Salmon River from Sunbeam to Bonanza. Forest Service Road 172 follows Jordan Creek to Loon Creek Summit, and down Mayfield and Loon Creeks to Transfer Creek campground, approximately 34 miles from Sunbeam (fig. 1). Idaho State Highway 75 links Challis to the east with Stanley and Ketchum to the west and south of Sunbeam.

The stream gradient of Loon Creek is about 80 ft/mile with an average annual discharge of 100 ft^3/sec. Placers of probable Pleistocene age (Ross, 1941a, p. 43) occur along Loon Creek, at an elevation of about 5,600 ft, from the old townsite of Casto to the mouth of Shell Creek, a distance of about 4.5 miles; these bars are shown on figure 25. They have an average width of 1,000 ft and comprise the elevated flood plain of the creek and terraces which are up to 100 ft above the present channel (Ross, 1941a, p. 43). These gravels average 6 to 8 ft thick but are up to 40 ft thick on an irregular bedrock surface of granite or schist. As evidence of past mining activity, washed boulders and oversize material lie on an irregular bedrock surface which ranges from 5 to 25 ft above the present stream level along both sides of the creek.

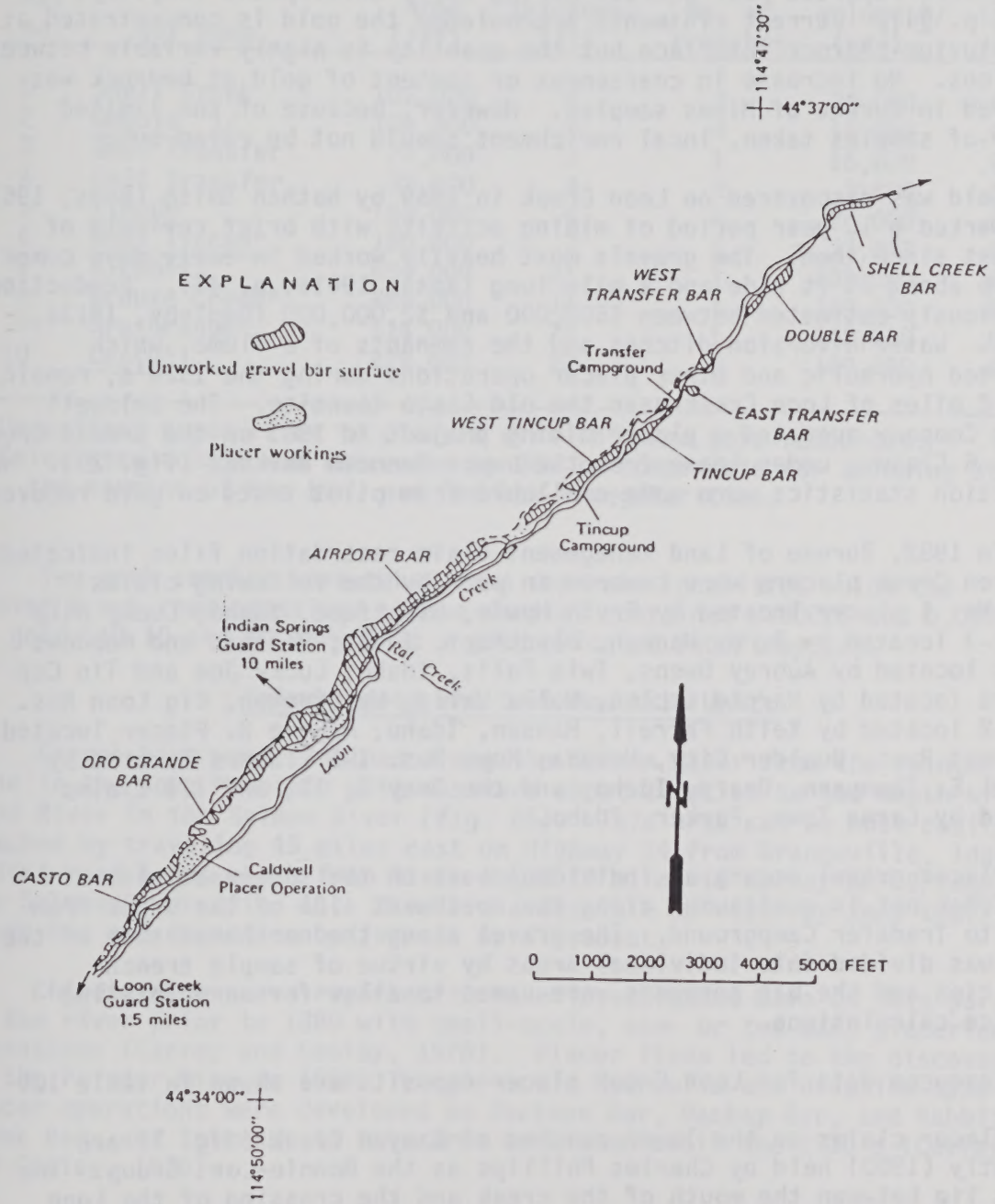


FIGURE 25.—Loon Creek gold placers, Custer County, Idaho

The poorly-sorted, very loosely-cemented material in the bars is principally coarse sand to cobble size with less than 10% boulders and almost no clay. Fine to very, very-fine sized gold is uniformly distributed throughout the deposits. Coarse gold, with nuggets weighing up to an ounce, were reported near bedrock during early development (Umpleby, 1913a, p. 94). Current claimants acknowledge the gold is concentrated at the alluvium-bedrock interface but the quantity is highly variable between locations. No increase in coarseness or content of gold at bedrock was observed in Bureau of Mines samples. However, because of the limited number of samples taken, local enrichment should not be ruled out.

Gold was discovered on Loon Creek in 1869 by Nathan Smith (Ross, 1963) and sparked a 10 year period of mining activity with brief revivals of interest since then. The gravels most heavily worked in early days comprise a strip about 75 ft wide and a mile long (Ross, 1941a, p. 43). Production is variously estimated between $500,000 and $2,000,000 (Umpleby, 1913a, p. 91). Water diversion ditches and the remnants of a flume, which supported hydraulic and other placer operations during the 1920's, remain along 2 miles of Loon Creek near the old Casto townsite. The Caldwell Mining Company operated a placer mining project in 1983 on the Grouse Creek Nos. 1-6 Claims, under lease from the owner Kenneth Belknap (fig. 29). No production statistics were made available from pilot tests on gold recovery.

In 1982, Bureau of Land Management claim recordation files indicated the Loon Creek placers were covered in part by the following claims: Howie No. 1 placer located by Ervin Howie, Blackfoot, Idaho; Lucky Mike Nos. 1-3 located by R. H. Hannah, Blackfoot, Idaho; Plateau and Meadows Claims located by Aubrey Owens, Twin Falls, Idaho; Lucky Joe and Tin Cup Placers located by Harold Eccles, Walla Walla, Washington; Big Loon Nos. 1 and 2 located by Keith Farrell, Hansen, Idaho; Maggie R. Placer located by Forest Rust, Boulder City, Nevada; Hope Nos. 1-5 Placers located by Michael E. Thompson, Deary, Idaho; and the Oney I, II, and III Claims located by Carma Tews, Parker, Idaho.

Placer gravel occurs as individual bars on the southeast side of Loon Creek but is continuous along the northwest side of the creek from Casto to Transfer Campground. The gravel along the northwest side of the creek was divided into individual areas by virtue of sample trench localities and the bar segments were named to allow for more detailed resource calculations.

Resource data for Loon Creek placer deposits are shown in table 10.

Placer claims on the lower reaches of Canyon Creek (fig. 7) are currently (1983) held by Charles Phillips as the Bonnie-Lori Group. The claims lie between the mouth of the creek and the crossing of the Loon Creek-Beaver Creek road. The local gradient of the swiftly flowing stream is about 600 ft/mile. During the summer of 1982, Phillips operated a backhoe on the claims, but in 1983 there was no trace of the previous summer's work. Because of the steepness of the topography and the stream, there is not much chance for appreciable amounts of gravel, although Canyon Creek undoubtedly transported the gold deposited downstream in Loon Creek.

TABLE 10.--Resources and sample data for the Loon Creek gold placers

[Bars with an asterisk (*) are partly outside the Wilderness]

Map no.	Bar name	Area (ft^2)	Estimated thickness (ft)	No. of trenches	Estimated volume 2/ (yd^3)	Gold (oz/yd^3)
1	Shell Creek	102,000	8	2	24,000	0.0032
2	Double 1/	104,000	6	4	18,000	.0243
3	West Transfer	77,000	7	1	16,000	.0042
4	East Transfer	32,000	4	2	3,800	.0049
5	Tincup	144,000	6	4	26,000	.0192
6	West Tincup*	160,000	7	1	33,000	.0171
7	Airport*	854,000	21	1	531,000	.0030
8	Grouse Creek*	889,000	14	1	369,000	.0001
9	Oro Grande*	514,000	29	1	442,000	.0025
10	Casto*	229,000	22	2	149,000	.0087

1/ Underlined names refer to placers with inferred gold resources.
2/ Calculated volume was decreased by 20% to compensate for thinning at the margins of the bar, and bedrock irregularities.

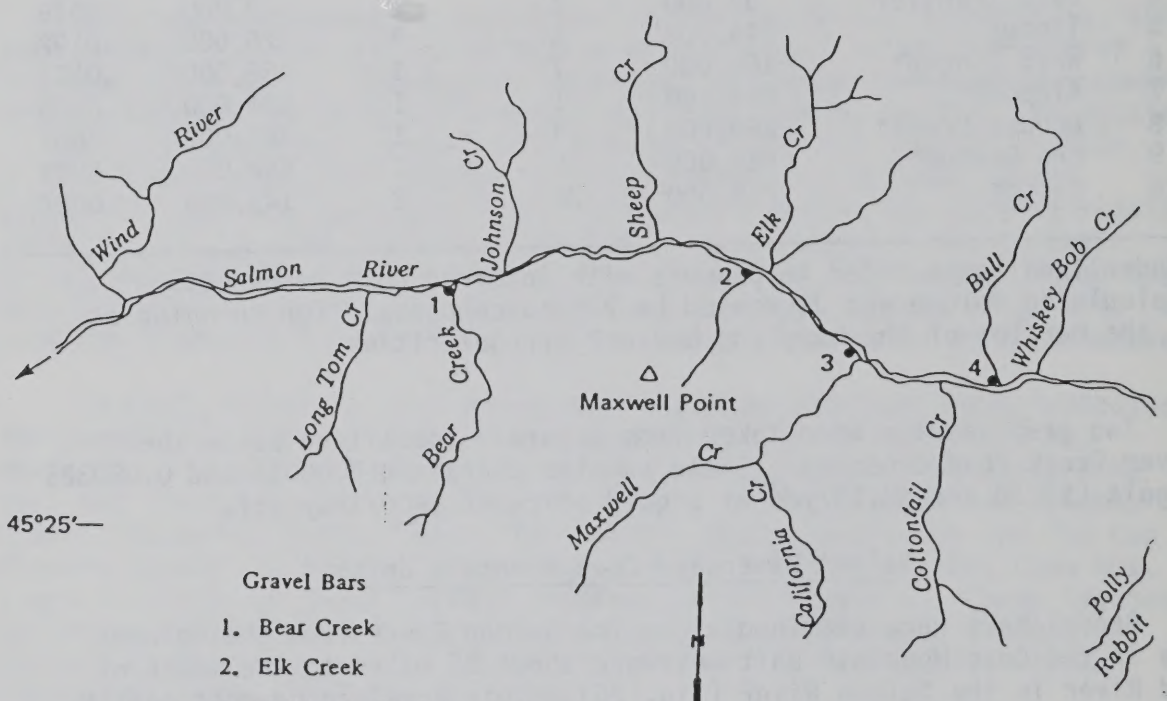
Two grab samples were taken from separate localities below the Beaver Creek road crossing. These samples contained 0.00025 and 0.000325 oz gold ($0.10 and $0.13/$yd^3$ at a gold price of $400/troy oz).

Salmon River and Cove Mountain Units

Gravel bars were examined along the Salmon River from the Painter Mine in the Cove Mountain unit westward about 25 miles to the mouth of Wind River in the Salmon River (fig. 26). This area can be most easily reached by traveling 45 miles east on Highway 14 from Grangeville, Idaho. A dirt road leads south from Dixie about 20 miles to Mackay Bar Bridge on the Salmon River (fig. 1). Bars are accessible up river by jeep trail to Haney Bar and downriver by jetboat or floatboat.

Chinese miners are reported to have investigated bars on this part of the river prior to 1880 with small-scale, one- or two-man, placering operations (Carrey and Conley, 1978). Placer finds led to the discovery of the Painter Mine in 1908. Larger-scale hydraulic and dragline-type placer operations were developed on Jackson Bar, Mackay Bar, and Rabbit Creek Bar, and interest in this area continued until the 1930's (Carrey and Conley, 1978).

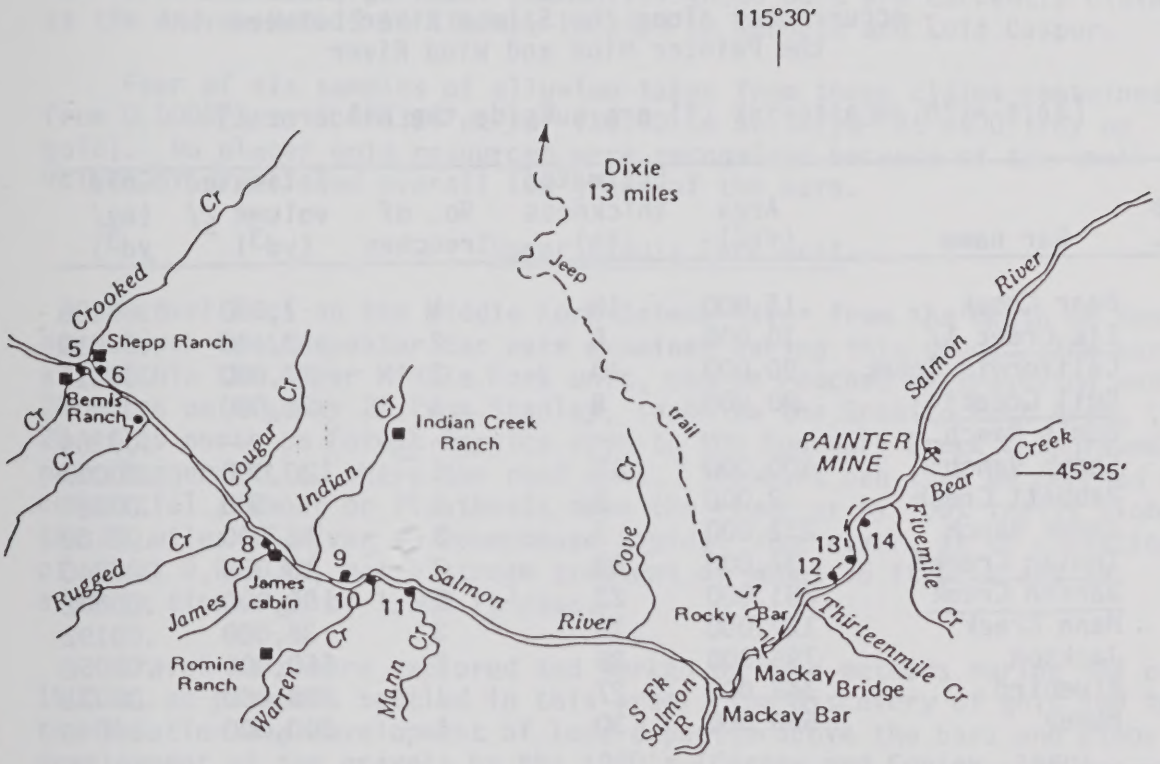
The river, at an elevation of about 2,200 ft near Mackay Bar, has an average annual discharge of 11,000 ft^3/sec on a gradient of about 11 ft/mile.



Gravel Bars

1. Bear Creek
2. Elk Creek
3. California Creek
4. Bull Creek
5. Bemis Ranch
6. Shepp Ranch
7. Rabbit Creek
8. James Ranch
9. Indian Creek
10. Warren Creek
11. Mann Creek
12. Jackson
13. Bluebird
14. Haney

FIGURE 26.—Salmon River gold placers and occurrences between



the Painter Mine and Wind River, Idaho County, Idaho

Fourteen bars were evaluated in this area and perched gravels were identified above Blue Bird Bar. The alluvium in the bars is principally coarse sand to cobble size with up to 10% boulders and is loosely cemented with very little interstitial clay. The material is poorly sorted and only locally stratified. The bars average 6 to 8 ft thick and may be up to 30 ft thick locally. Sample trenches generally encountered water at river level and bedrock was seldom uncovered. Fine to very-fine size, subrounded to angular, flat, bright gold was fairly uniformly distributed throughout the samples. Horizons of greater gold content were identified at Bull Creek, Warren Creek, Elk Creek, and Indian Creek Bars. Resource data for these bars are on table 11.

TABLE 11.--Resources and sample data for gold placers and occurrences along the Salmon River between the Painter Mine and Wind River

[Bars with an asterisk (*) are outside the Wilderness]

Map no.	Bar name	Area (ft^2)	Estimated thickness (ft)	No. of trenches	Estimated volume 2/ (yd^3)	Gold (oz/yd^3)
1	Bear Creek	15,000	16	1	7,000	0.00105
2	Elk Creek 1/	10,000	8	2	2,400	.00910
3	California Creek	90,000	10	2	27,000	.00017
4	Bull Creek*	90,000	8	3	21,000	.01007
5	Bemis Ranch	--	--	-- 3/	--	.00184
6	Shepp Ranch*	400,000	10	1	120,000	.00007
7	Rabbitt Creek	2,000	8	1	500	.00027
8	James Ranch	231,000	7	3	48,000	.00102
9	Indian Creek*	37,000	12	2	13,000	.00840
10	Warren Creek	281,000	22	5	180,000	.00532
11	Mann Creek	127,000	10	3	38,000	.00192
12	Jackson	795,000	28	2	660,000	.00050
13	Bluebird	348,000	27	1	280,000	.00031
14	Haney	566,000	30	1	500,000	.00046

1/ Underlined names refer to placer with inferred gold resources. Estimated thickness indicates only resource-bearing intervals.
2/ Calculated volume decreased by 20% to compensate for thinning at the margins of the bar, and bedrock irregularities.
3/ Grab sample only; no volume estimated.

Small gravel bars occur along the South Fork Salmon River over a distance of 5 miles from the mouth of Knob Creek to the mouth of Rooster Creek and extend beyond the study area to the southwest (fig. 21). The area can be reached by traveling eastward from Burgdorf, Idaho, about 25 miles on dirt roads to the mouth of Smith Creek, then 2 miles by foot trail along the South Fork Salmon River. The bars are generally less than 300 ft long and 50 ft wide. Thickness of the bars is unknown, but considering the precipitous topography, probably is less than 30 ft. Workings were not found within the study area; however, approximately 2,500 ft of ditch was dug by Chinese miners in an attempt to bring water to Cougar Bar, adjacent to the study area. The Chinese were forced off their claims by white miners before any production was realized (Steve and Karen Knudtsen, personal commun.). These bars are currently claimed as the Andrew Nos. 5-14 Claims, located by Kenneth and Lois Casper.

Four of six samples of alluvium taken from these claims contained from 0.000075 to 0.003324 oz/yd^3 ($0.03 to $1.33/yd^3 at $400/troy oz gold). No placer gold resources were recognized because of the small volume of gravel and overall low grade of the bars.

Upper Middle Fork Unit

Gravel bars on the Middle Fork Salmon River from the mouth of Deer Horn Creek to Sheepeater Bar were examined during this study. The bars, all within the Upper Middle Fork unit, can be reached by traveling westward 20 miles on Highway 21 from Stanley, Idaho to the Granite Rest Area, then 20 miles north on Forest Service road to the Boundary Creek Campground, near Dagger Falls, where the road ends. The bars can then be reached by commercial jetboat or floatboats down the river or by foot trails along the 11 miles of river to Powerhouse Rapids. The river, at an elevation of about 5,200 ft, has a stream gradient of about 35 ft/mile and an average discharge of 1,500 ft^3/sec.

Gravel bars were explored and worked by hand methods during the early 1900's, as pioneers settled in this area. The discovery of gold led to the location and development of lode deposits above the bars and minor development of the gravels by the 1920's (Carrey and Conley, 1980). Hand-fashioned wooden water diversion pipes, small bucket dredges, one hydraulic giant, and sluice boxes were used to recover gold from bars in this area during the 1930's (Carrey and Conley, 1980). There has been no mining activity since that time and little evidence of past activity remains. Poor access to the middle reaches of the Middle Fork Salmon River has always proved a major obstacle to settlement and mineral development.

Four bars were evaluated in this area (fig. 27). The material in the bars is primarily coarse sand to cobble size with up to 10% boulders, is loosely cemented, and contains almost no clay. The bars average 6 ft thick with a maximum observed thickness of 23 ft. Perched gravel occurs up to 100 ft above river level at Sheepeater Bar. Sample trenches reached the water table at river level and bedrock was not encountered. Fine to very-fine sized gold was fairly uniformly distributed throughout all samples and layers of enrichment within the bars were not identified.

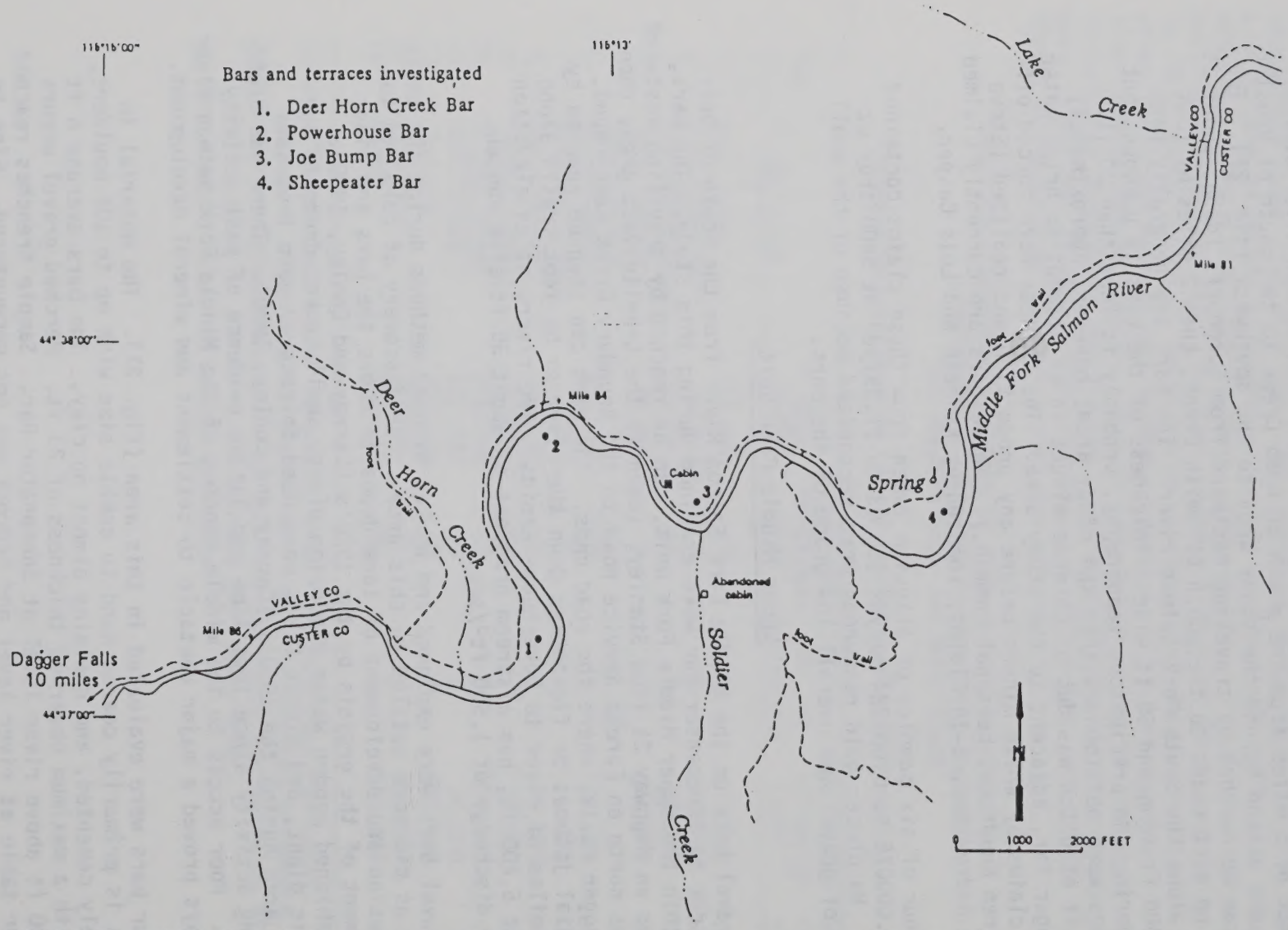


FIGURE 27.–Middle Fork Salmon River gold placers near the mouth of Soldier Creek, Custer and Valley Counties, Idaho

Resource data for bars in the Middle Fork unit are shown in table 12.

TABLE 12.--Resources and sample data for gold placers on the Middle Fork Salmon River near the mouth of Soldier Creek

Map no.	Bar name	Area (ft^2)	Estimated thickness (ft)	No. of trenches	Estimated volume 2/ (yd^3)	Gold (oz/yd^3)
1	Deer Horn Creek	287,000	14	1	119,000	0.00011
2	Powerhouse	188,000	3/	1	3/	.00001
3	Joe Bump 1/	220,000	5	2	33,000	.00611
4	Sheepeater	357,000	20	2	212,000	.00003

1/ Underlined name refers to placers with inferred gold resources.
2/ Calculated volume was reduced by 20% to allow for gravel thinning at the margins of the bar, and bedrock irregularities.
3/ Could not be determined from available exposures.

Magruder-Blue Joint Unit

Placer claims within the Magruder area are primarily clustered on Deep Creek (fig. 22) near the Hells Half Acre road junction. The Goodyear Nos. 1-3 Claims parallel the road along Deep Creek. Grab samples of alluvium from the vicinity of these claims show at best only a trace gold. One sample taken on Slow Gulch about 2 miles west of the headwaters contained 0.0000025 oz gold from two level 14-in. diameter pans; this is equivalent to $0.10/$yd^3$ at a gold price of $400/oz. Grab samples of alluvium taken from placer claims within or abutting the Blue Joint area all showed only a trace gold. One sample taken on Reynolds Creek about 1 mile northwest of the East Fork Reynolds Creek junction had 0.0000113 oz gold, or an equivalent value of $0.0045/$yd^3$. Volume of alluvium at all sites is small.

BLACK SAND DEPOSITS AND OCCURRENCES

Heavy detrital minerals occur in placer deposits throughout the central Idaho region underlain by batholithic rocks. The predominantly dark minerals, at least 50 of which have been identified, are collectively called "black sands." Many reports have been written describing the location and composition of the occurrences and deposits; the most comprehensive of these is by Savage (1961a). Kauffmann and Baber (1956) reviewed the potential of Pacific Northwest black sand deposits. Eilertsen and Lamb (1956) reviewed the Bureau of Mines' exploration program for these deposits. Truesdell and others (1977) discuss origin of the Bear Valley placers, one of the major accumulations of such black sands in Idaho.

Although black sands have long been known in the placers of Idaho, they were not considered potentially commercial until the late 1940's when government stocks of monazite were seriously depleted in response to export restrictions by India and Brazil (Eilertsen and Lamb, 1956, p. 4). Bureau of Mines investigations in central Idaho included 27 projects, beginning in 1948 and ending in 1955, and resulted in commercial operations near Cascade in 1950, and in Bear Valley in 1951 (Eilertsen and Lamb, 1956, p. 4). The government monazite stockpile was filled in 1955 and new contracts were unobtainable (Eilertsen and Lamb, 1956, p. 25). However, Porter Brothers Corp. continued operation in Bear Valley until 1960, when forced to cease because of difficulty in marketing rare-earth elements (Truesdell and others, 1977, p. 2; Savage, 1961b, p. 18). In addition to radioactive and rare-earth bearing minerals, Porter Brothers recovered, as by-products, magnetite, ilmenite, zircon, and garnet (Truesdell and others, 1977, p. 2). The minerals of economic interest during this period were euxenite, brannerite, samarskite, xenotime, monazite, uranothorite, ilmenite, zircon, tantalite, columbite, thorite, and allanite (Savage, 1961a, p. 14). Although originally mined for their radioactive element content, the black sands contain so-called "space-age" metals such as zirconium, hafnium, titanium, niobium, tantalum, thorium, scandium, and yttrium (Savage, 1961b, p. 1). It is unlikely that these black sand deposits could be exploited for a single commodity, as has been demonstrated by the relatively short length of time some of these were mined. Prater (1957, p. 13) observed that use of multiple black sand components and development of a local industry to consume the commodities were keys to successful exploitation of the deposits.

Two areas within and adjacent to the Wilderness were identified as black sand occurrences. These are the Hoodoo Meadows-Yellowjacket Creek and the Elk Creek-lower Bear Valley areas (fig. 24).

Hoodoo Meadows-Yellowjacket Creek Area

U.S. Bureau of Mines reconnaissance in 1954 in the headwaters of Yellowjacket and Hoodoo Creeks identified radioactive black sand deposits in this part of central Idaho (Reynolds, 1954). These occur along Yellowjacket Creek, its West Fork tributary, and along the northern boundary of the Yellowjacket unit at Hoodoo and Frog Meadows (fig. 28). Most areas along Yellowjacket Creek are accessible only by trail, but the upper sections, including Hoodoo and Frog Meadows, are easily reached by road from late June through October.

Yellowjacket Creek in the study area is characterized by broad flat benches ranging from 5 to 20 ft above the creek. Near the lower end, benches considered to be remnants of a terminal moraine are estimated to be as much as 100 ft thick; seismic data for most of the creek basin indicates an alluvium thickness of less than 10 ft. Auger holes and stream cuts at Hoodoo and Frog Meadows suggest an alluvium and weathered bedrock thickness less than 5 ft. Because of the inaccessible nature of Yellowjacket Creek, only pan-size samples were taken; both bulk and pan samples were taken at Hoodoo and Frog Meadows. Whenever possible, sample locations were based on the highest gamma radiation as measured on a scintillometer, but most measurements were not much higher than background.

Twenty-six samples were processed in the laboratory using the same procedures for separating the black sand concentrates from other lighter minerals as for gold. Retention of some lighter minerals, however, was deemed necessary to limit the loss of radioactive mineral grains, some of which have specific gravities significantly lower than magnetite. Density measurements using a Jolly balance and microscopic inspection of four sample concentrates showed that the concentrates contained significant amounts of quartz, feldspar, and other lighter minerals. Therefore, the resulting final sample density was lower than a typical black sand concentrate.

Radioactive minerals reported by Reynolds (1954), include allanite, cyrtolite, thorite, columbite, samarskite, and minor monazite. Analyses of one sample taken during this study identified thorite and monazite as the most abundant radioactive minerals. Allanite and columbite were also detected along with minor amounts of fergusonite, thalenite, and ferberite. No samarskite was detected as previously reported. The source of these radioactive minerals is considered to be the Crags Pluton exposed to the north (Bennett, 1980a).

Reynolds (1954) reported that 10 million yd^3 containing 1 lb/yd^3 of monazite equivalent may be present in the areas studied. The volume is probably reasonable, but the amount of equivalent monazite does not agree with 1982 findings. Results of 32 analyses show ThO_2 ranges from 0.00003% to 0.001%. At 2,700 lbs/yd^3 of dry gravel the highest ThO_2 result equates to 0.03 lb/yd^3; U_3O_8 results were lower, ranging from 0.000003% to 0.0003%. Because of the low values, limited accessibility, and current low demand for uranium and thorium, these placers are classified as occurrences.

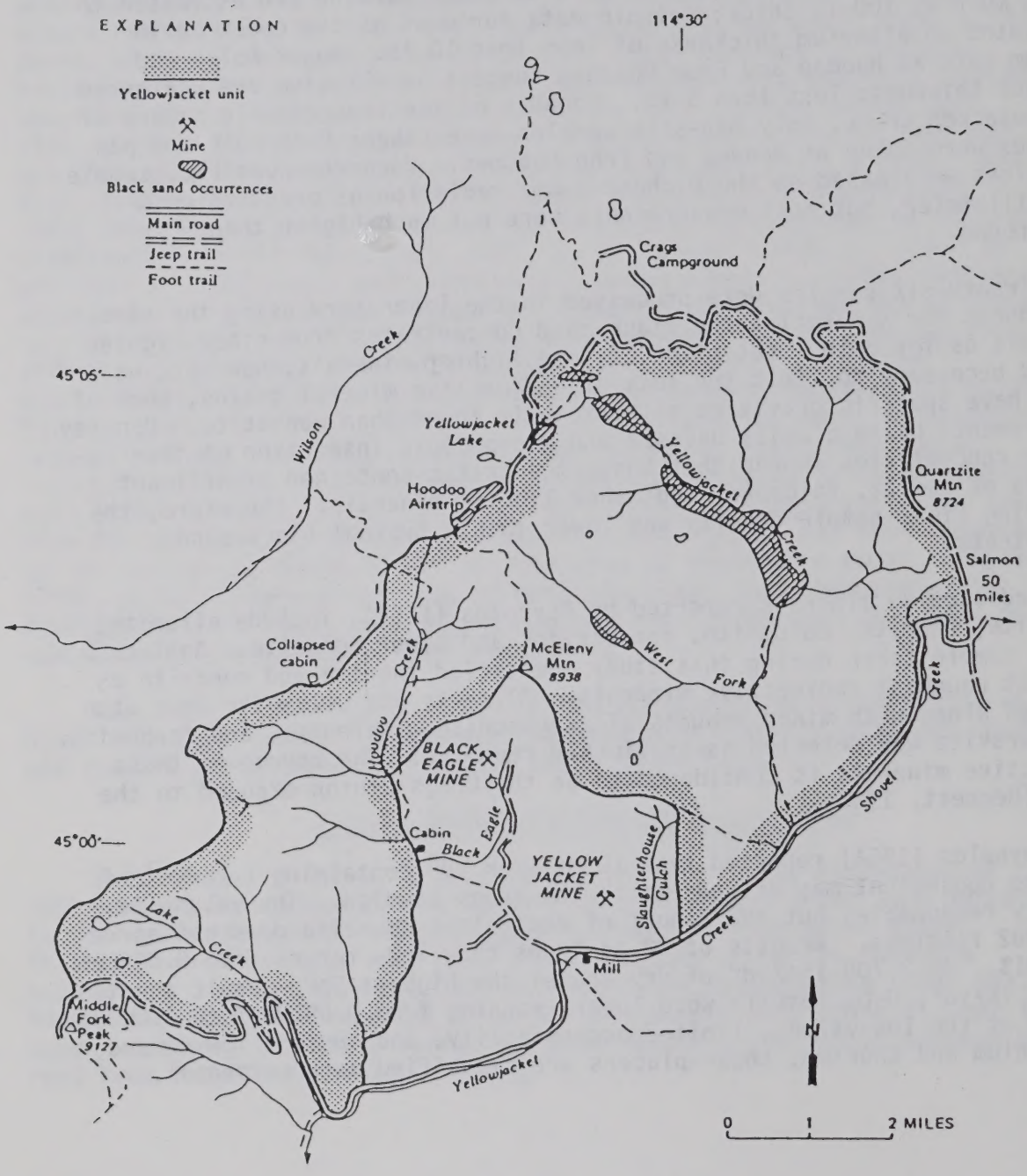


FIGURE 28.—Black sand occurrences in the Yellowjacket unit, Lemhi County, Idaho

Lower Bear Valley-Elk Creek Area

Reconnaissance drilling conducted by the Bureau of Mines in the lower reaches of Bear Valley (fig. 29) indicates that the content of monazite, euxenite, and columbite per yd^3 of alluvium is uniformly less than in the upper reaches of the drainage (Kline and others, 1953, p. 5). These studies indicate the highest-grade placers, with respect to these three minerals, occur in the vicinity of Casner and Howard Creeks approximately 10 miles south of the confluence of Elk and Bear Valley Creeks (Kline and others, 1953). Radiometric determinations of uranium in these drainages tend to confirm a local source (Truesdell and others, 1977, p. 14). However, Kline and others (1953, p. 5) do not report the content of other black sand components such as magnetite, ilmenite, garnet, and zircon. Private interests also conducted drilling programs in the drainage, with different results. For example, Porter Brothers Corp. drilled some holes in which black sand content was significantly higher adjacent to the Bureau' holes (Russell Wood, personal commun., 1982). Some of the Bureau's drilling was conducted in the central part of Poker Meadows and Rare Metals Corp. tested targets in the western part of the meadows. Wood stated (personal commun., 1982) that he has been unable to locate the position of most of these test sites because of the poor quality of available maps. Documents supplied by Wood show a northwest-trending line of Bureau drill holes with black sand concentrations ranging from 20 to 30 lb/yd^3 in the vicinity of Bruce Meadows landing field (fig. 29) and from 4 to 8 lb/yd^3 in the central part of Poker Meadows. Rare Metals Corp. drilling records from the western part of Poker Meadows show black sand concentates ranging from 4.5 to 24.3 lb/yd^3. The quantity of monazite, euxenite, and other minerals of commercial interest is unknown. Because much of the area of Elk Creek and lower Dagger Creek drainages are underlain by the same rock types (Fisher and others, 1983) as those in the area immediately east of upper Bear Valley (Truesdell and others, 1977, p. 7-8), Ayers Meadow as well as the flat areas of middle Elk Creek are likely to contain similar black sand concentrations. As part of this study, the Bureau had planned a limited reconnaissance drilling program to test these areas. However, the drilling was cancelled because of environmental concerns of the U.S. Forest Service. Areas of suspected black sand resources are shown on figure 29.

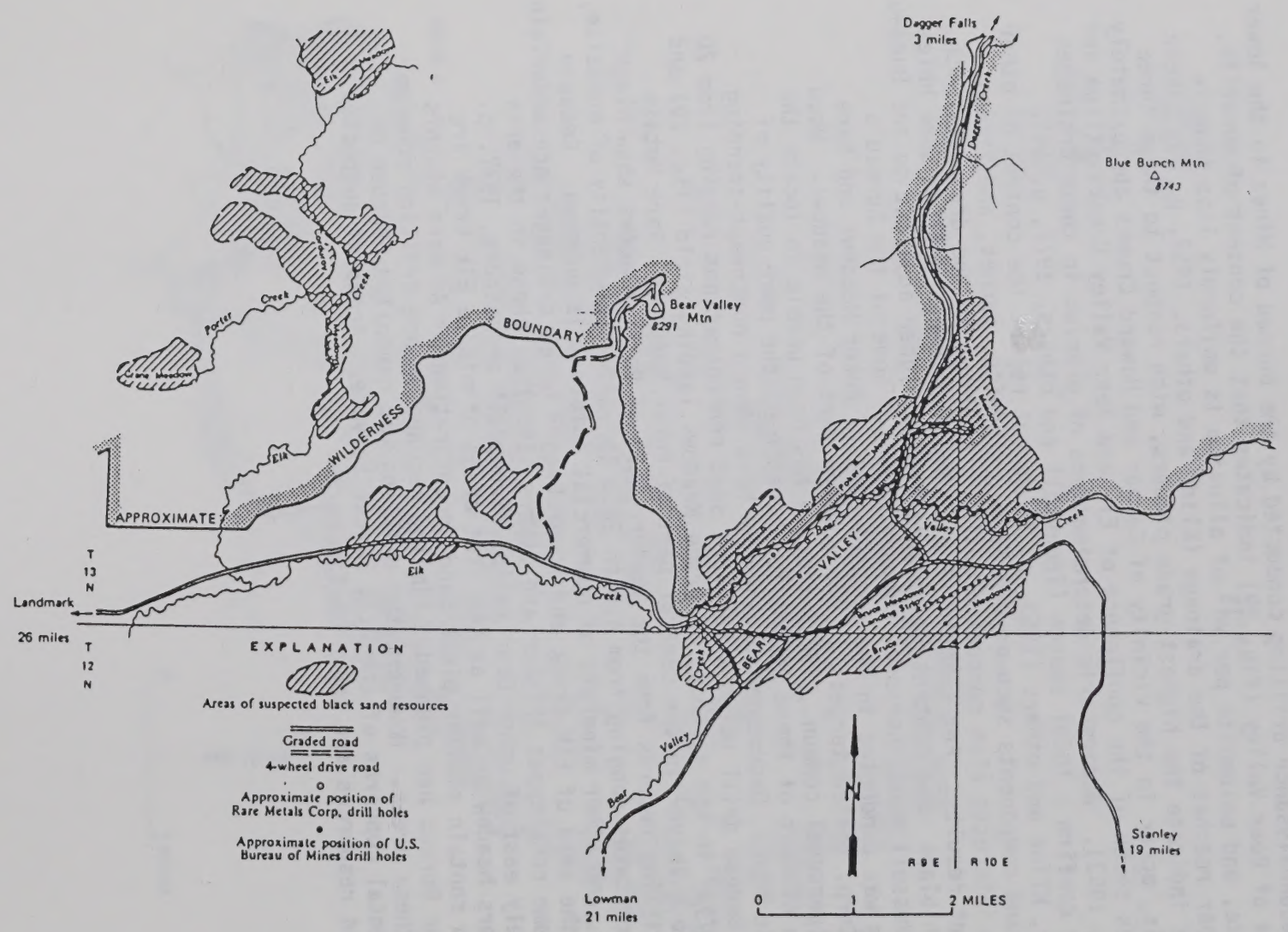


FIGURE 29.—Areas of suspected black sand occurrences in the Lower Bear Valley-Elk Creek area, Valley County, Idaho

ASSESSMENT OF PLACER RESOURCES

Because of the relatively high gold content at Double, Tincup and West Tincup Bars (table 13), a feasibility study was conducted to determine what price of gold would be needed to economically mine them. The feasibility study was based on processing 120 yd^3/day, 10 hours/day, 6 days/week for 5 to 6 months a year as weather permits. The total life of the operation would be approximately five years. Because the three bars are located in close proximity to each other, they would be mined consecutively by a single operator, requiring only one capital investment. Used equipment would be purchased at 14% interest and sold following completion of the operation. Employees would consist of a foreman and two operators. All sites would be reclaimed. The feasibility study included an economic evaluation using the Bureau's MINSIM (mine simulator) program (U.S. Bureau of Mines, 1983). The MINSIM evaluation was run twice, the first assuming average operating conditions and efficiency, the second assuming optimium operation conditions and maximum efficiency.

TABLE 13.--Resources of the proposed Loon Creek placer operation

Bar name	Resources		
	Estimated volume (yd^3)	Average gold content (oz gold/yd^3)	Value ($/$yd^3$) 1/
Double	18,000	0.0243	9.72
Tincup	26,000	.0192	7.68
West Tincup	33,000	.0171	6.84
Totals	77,000	.0194	7.76

1/ At $400/troy ounce.

Results of the evaluation indicate that a gold price of $368/troy oz would be required to yield a zero rate of return (ROR) on the investment and a price of $418/troy ounce to yield a 15% ROR for average operating efficiency. However, gold values of $329/troy oz and $375/troy oz would be required for zero and 15% rates of return, respectively, assuming optimum conditions and efficiency. Based on these results, the three bars combined could be processed at marginal profits with typical operating efficiency and economically with good management and operating personnel. Therefore, the combined resources of these three bars average $7.76/$yd^3$ and are classified as marginally economic (marginal reserves) at a gold price of $400/troy oz.

Casto Bar, also partly within the Wilderness, has 150,000 yd^3 averaging \$3.48/yd^3 at a gold price of \$400/troy ounce and is classified as a subeconomic resource. Six other bars in the Loon Creek-Warm Spring Creek unit are classified as occurrences; these are Oro Grande, Grouse Creek and Airport Bars, which are partly within the Wilderness, and East Transfer, West Transfer, and Shell Creek Bars totally within the Wilderness. Individual bars from the mouth of Canyon Creek to Airport Bar are apparently too low grade to be considered resources at a gold price of \$400/troy oz. However, when considered collectively, the volume of material from Casto Bar to Airport Bar is estimated at 1.5 million yd^3. Should enrichment of gold occur at bedrock or intervals within the gravel identified by additional sampling, the volume is sufficient to support a large-scale, mechanized placer operation. Because of the 600-ft-wide non-wilderness corridor along the Loon Creek road, most of the placer deposits lie outside the Wilderness. The large volume of gravel and past production from these suggests the need for additional sampling.

Four bars on the Salmon River have subeconomic resources at a gold price of \$400/troy oz. These are Warren Creek Bar (180,000 yd^3 valued at \$2.19/yd^3), Elk Creek Bar (2,400 yd^3 valued at \$3.64/yd^3), Indian Creek Bar (13,000 yd^3 valued at \$3.36/yd^3) within the Wilderness, and Bull Creek Bar (21,000 yd^3 valued at \$4.03/yd^3). Of these, only Warren Creek Bar has sufficient volume to support a highly mechanized placer operation; the other three would only support a small-scale, labor-intensive operation. Jackson, Bluebird, and Haney Bars have sufficient tonnage to support a large-scale placer operation should additional sampling indicate areas of much higher grade within those bars. These bars are wholly within the Wilderness.

Joe Bump Bar on the Middle Fork Salmon River has 33,000 yd^3 of inferred subeconomic resources, valued at \$2.44/yd^3; Powerhouse, Deer Horn, and Sheepeater Bars are classified as occurrences. Sheepeater Bar has sufficient volume to support a large-scale placer operation should additional sampling indicate areas of higher grade within that bar. All bars are within the Wilderness.

Small gravel bars along the South Fork of the Salmon River in the Salmon River unit of the Wilderness, along creeks in the Magruder-Blue Joint unit adjacent to the Wilderness, and on lower Canyon Creek in the Loon Creek-Warm Spring unit of the Wilderness are classified as occurrences because of low grade and/or volume.

Black sand deposits in the Hoodoo Meadows-Yellowjacket Creek area are classified as occurrences. In the southwestern part of the Wilderness, Ayers Meadow and the middle reaches of Elk Creek drainage in the Wilderness are suspected to have black sand resources based on geologic inference.

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REFERENCES

Abstein, H. T., no date, Missouri Copper Cliffs: unpublished private report on file at Western Field Operations Center, U. S. Bureau of Mines, Spokane, Washington, 3 p.

Anderson, A. L., and Rasor, A. C. 1934, Silver mineralization in the Banner district, Boise County, Idaho: Econ. Geology, v. 29, no. 4, p. 371-378.

Anderson, A. L., 1942, The Boise Basin, Idaho, in Newhouse, W. H., ed., Ore deposits as related to structural features, chapt. III, part II: Princeton, New Jersey, Princeton Univ. Press, p. 132-134.

_____, 1943a, The antimony and fluorspar deposits near Meyers Cove, Lemhi County, Idaho: Idaho Bureau of Mines and Geology Pamph. 62, 20 p.

_____, 1943b, A preliminary report on the cobalt deposits in the Blackbird district, Lemhi County, Idaho: Idaho Bureau of Mines and Geology Pamph. 61, 34 p.

_____, 1947a, Cobalt mineralization in the Blackbird district, Lemhi County, Idaho: Econ. Geology, v. 42, no. 1, p. 22-46.

_____, 1947b, Geology and ore deposits of Boise Basin, Idaho: U. S. Geological Survey Bull. 944-C, p. 121-316.

_____, 1948, Role of the Idaho batholith during the Laramide orogeny: Econ. Geology, v. 43, no. 2, p. 84-99.

_____, 1949, Silver-gold deposits of the Yankee Fork district, Custer County, Idaho: Idaho Bureau of Mines and Geology Pamph. 83, 37 p.

_____, 1951, Metallogenic epochs in Idaho: Econ. Geology, v. 46, no. 6, p. 592-607.

_____, 1953, Gold-copper-lead deposits of the Yellowjacket district, Lemhi County, Idaho: Idaho Bureau of Mines and Geology Pamph. 94, 41 p.

_____, 1954a, Fluorspar deposits near Meyers Cove, Lemhi County, Idaho: Idaho Bureau of Mines and Geology Pamph. 98, 34 p.

_____, 1954b, A preliminary report on the fluorspar mineralization near Challis, Custer County, Idaho: Idaho Bureau of Mines and Geology Pamph. 101, 12 p.

_____, 1963a, Contact syenitization in the Yellowjacket district, Lemhi County, Idaho: Amer. Jour. Science, v. 261, no. 9, p. 826-838.

_____, 1963b, Yellowjacket intrusive complex, Lemhi County, Idaho: Northwest Science, v. 37, no. 1, p. 1-21.

Anderson, J. A., 1982, Gold - its history and role in the U. S. economy and the U. S. exploration program of Homestake Mining Co.: Mining Congress Jour., v. 68, no. 1, p. 51-58.

Anonymous, 1925, Bunker Hill opens good ore in Deadwood Basin: Engineering and Mining Journal-Press, v. 119, no. 21, p. 858.

Arbogast, Belinda, Millard, H. T., Rehn, W. M., Coxe, B. W., and Lund, Karen, 1982, Analyses for fluorine, mercury, silver, thorium, tungsten, and uranium in rocks from the Blue Joint Wilderness Study Area, Ravalli County, Montana, and the Blue Joint Roadless Area, Lemhi County, Idaho: U. S. Geological Survey Open-File Report 82-1031, 16 p.

Armstrong, R. L., 1974, Geochronometry of the Eocene volcanic-plutonic episode in Idaho: Northwest Geology, v. 3, p. 1-15.

_____, 1975a, The geochronometry of Idaho: Isochron/West, no. 14, p. 1-50.

_____, 1975b, Precambrian (1500 m.y. old) rocks of central Idaho--the Salmon River Arch and its role in cordilleran sedimentation and tectonics: Am. Jour. Science, v. 275-A, p. 437-476.

_____, 1976, The geochronometry of Idaho: Isochron/West, no. 15, p. 1-33.

Armstrong, R. L., Hollister, V. F., and Harakel, J. E., 1978, K-Ar dates for mineralization in the White Cloud-Cannivan porphyry molybdenum belt of Idaho and Montana: Econ. Geology, v. 73, p. 94-96.

Armstrong, R. L., 1978, Cenozoic igneous history of the U. S. cordillera from lat. 42° to 49° N, in Smith, R. B., and Eaton, G. P., eds., Cenozoic tectonics and regional geophysics of the western cordillera: Geol. Soc. America Mem. 152, p. 265-282.

Baker, A. C., 1948, Statement of facts as the the location and nature of mineral deposits: unpublished statement regarding the Copper Cliffs property on file at Western Field Operations Center, U. S. Bureau of Mines, Spokane, Washington, 2 p.

Bancroft, G. J., 1925, A report on the War Eagle Mine, Idaho County, Idaho: unpublished manuscript on file at Western Field Operations Center, U. S. Bureau of Mines, Spokane, Washington, 23 p.

Beckwith, R. H., 1926, Quartz veins of the Buffalo Hump: Pan American Geologist, V. 46, p. 111-120.

_____, 1927, Ore deposition at Buffalo Hump: Pan American Geologist, v. 48, no. 3. p. 191-194.

Beckwith, R. H., 1904, Report of the mining districts of Idaho for the year 1904, 139 p.

_____, 1928, The geology and ore deposits of the Buffalo Hump district: Annals, New York Acad. of Sciences, vol. 30, p. 263-296.

Bell, R. N., 1903, Report of the mining districts of Idaho for the year 1903, 145 p.

_____, 1905, Seventh annual report of the mining industry of Idaho for the year 1905, 149 p.

_____, 1906, Eighth annual report of the mining industry of Idaho for the year 1906, 175 p.

_____, 1907, Ninth annual report of the mining industry of Idaho for the year 1907, 217 p.

_____, 1908, Tenth annual report of the mining industry of Idaho for the year 1908, 27 p.

_____, 1911, Thirteenth annual report of the mining industry of Idaho for the year 1911, 133 p.

_____, 1912a, Fourteenth annual report of the mining industry of Idaho for the year 1912, 190 p.

_____, 1912b, Big Creek gold district, Idaho: Eng. & Mining Jour., v. 94, no. 19, p. 891-892.

_____, 1913, Fifteenth annual report of the mining industry of Idaho for the year 1913, 225 p.

_____, 1914, Sixteenth annual report of the mining industry of Idaho for the year 1914, 55 p.

_____, 1917, Nineteenth annual report of the mining industry of Idaho for the year 1917, 131 p.

_____, 1918, Twentieth annual report of the mining industry of Idaho for the year 1918, 135 p.

_____, 1919, Twenty-first annual report of the mining industry of Idaho for the year 1919, 180 p.

_____, 1929, Bunker Hill in the Deadwood Basin: Mining Truth, v. 14, no. 14, p. 7-9.

Bennett, E. H., 1977, Reconnaissance geology and geochemistry of the Blackbird Mountain-Panther Creek region, Lemhi County, Idaho: Idaho Bureau of Mines and Geology Pamph. 167, 108 p.

Bennett, E. H., 1980a, Granitic rocks of Tertiary age in the Idaho batholith and their relation to mineralization: Econ. Geology, v. 75, p. 278-288.

_____, 1980b, Preliminary geologic map of parts of the Warm Lake, Chinook Mtn., and Greyhound Ridge 15-minute quadrangles, Valley County, Idaho: Idaho Bureau of Mines and Geology Open-File Report 80-7, scale 1:62,500.

_____, 1981, Preliminary geologic map of the Greyhound Ridge, Idaho, 15-minute quadrangle: U. S. Geological Survey, unpublished map, scale 1:62,500.

Bennett, E. H., 1983, Tertiary plutons in central Idaho, in Fisher, F. S., and Johnson, K. M., compilers, Abstracts of the symposium on the geology and mineral deposits of the Challis 1° X 2° quadrangle, Idaho: U. S. Geological Survey Open-File Report 83-836, p. 5-6.

Bradley, J. D., Mecia, J. A., and Baker, R. E., 1943, Yellow Pine mine: Eng. & Mining Jour., v. 144, no. 4, p. 60-66.

Broxton, D. E., and Beyth, Michael, 1980, Uranium hydrogeochemical and stream sediment reconnaissance data release for the Elk City quadrangle, Idaho/Montana, including concentrations of forty-five additional elements: (contract DE-AC13-76-GJO 1664, Subcontract W-7405-ENG 36), 1980, U. S. Department of Energy Report GJBX-176 (80), Available through the U.S. Geological Survey Branch of Open File Services, Denver, Colorado, 212 p.

Campbell, Arthur, 1935, Thirty-seventh annual report of the mining industry of Idaho for the year 1935, 308 p.

Campbell, Stewart, 1924, Twenty-sixth annual report of the mining industry of Idaho for the year 1924, 249 p.

_____, 1927, Twenty-ninth annual report of the mining industry of Idaho for the year 1929, 280 p.

_____, 1929, Thirty-first annual report of the mining industry of Idaho for the year 1929, 300 p.

_____, 1930, Thirty-second annual report of the mining industry of Idaho for the year 1930, 270 p.

_____, 1931, Thirty-third annual report of the mining industry of Idaho for the year 1931, 298 p.

_____, 1935, Thirty-seventh annual report of the mining industry of Idaho for the year 1935, 308 p.

Canney, F. C., Hawkes, H. E., Richmond, G. M., and Vhay, J. S., 1953, A preliminary report of geochemical investigations in the Blackbird district: U. S. Geological Survey Open-File Report 53-31, 20 p.

Capps, S. R., 1939, The Dixie placer district, Idaho, with notes on the lode mines by R. J. Roberts: Idaho Bureau of Mines and Geology Pamph. 48, 35 p.

_____, 1940, Gold placers of the Secesh Basin, Idaho County, Idaho: Idaho Bureau of Mines and Geology Pamph. 52, 43p.

Carrey, Johnny, and Conley, Cort, 1978, River of No Return: Backeddy Books, Cambridge, Idaho, 319 p.

_____, 1980, The Middle Fork and the Sheepeater War: Backeddy Books, Cambridge, Idaho, 319 p.

Carter, C. H., 1981, The geology of part of the Yellowjacket mining district, Lemhi County, Idaho: unpublished M.S. thesis, Univ. of Idaho, 131 p.

Cater, F. W., Pinckney, D. M., Hamilton, W. B., Parker, R. L., Weldin, R. D., Close, T. J., and Zilka, N. T., 1973, Mineral resources of the Idaho Primitive Area and vicinity, Idaho: U. S. Geological Survey Bull. 1304, 431 p.

Cater, F. W., Pinckney, D. M., and Stotelmeyer, R. B., 1975, Mineral resources of the Clear Creek-Upper Big Deer Creek area, contiguous to the Idaho Primitive Area, Lemhi County, Idaho: U. S. Geological Survey Bull. 1391-C, 41 p.

Cavanaugh, P. C., 1979, The geology of the Little Boulder Creek molybdenum deposit, Custer County, Idaho: unpublished M.S. thesis, Univ. of Montana, 100 p.

Choate, Raoul, 1962, Geology and ore deposits of the Stanley area: Idaho Bureau of Mines and Geology Pamph. 126, 122 p.

Cole, J. W., and Bailey, H. D., 1948, Exploration, development, mining, and milling of a unique tungsten ore body at the Yellow Pine mine, Stibnite, Idaho: U. S. Bureau of Mines Info. Circ. 7443, 24 p.

Cole, W. C., 1956, Geology of the Blackbird Mine: unpublished report, Calera Mining Co.

Cooper, J. R., 1943, Report of preliminary examination: The Galena Central claims, Profile District, Valley County, Idaho: U. S. Geological Survey unpublished report on file at Western Field Operations Center, U. S. Bureau of Mines, Spokane, Washington, 4 p.

_____, 1951, Geology of the tungsten, antimony, and gold deposits near Stibnite, Idaho: U. S. Geological Survey Bull. 969-F, p. 151-197.

Cox, D. C., 1954, Fluorspar deposits near Meyers Cove, Lemhi County, Idaho: U. S. Geological Survey Bull. 1015-A, p. 1-21.

Currier, L. W., 1935, A preliminary report on the geology and ore deposits of the eastern half of the Yellow Pine district, Idaho: Idaho Bureau of Mines and Geology Pamph. 43, 27 p.

Dobey, A. B., 1972, Reconnaissance geology of the Meyers Cove Point quadrangle, Lemhi County, Idaho: M.S. thesis, Univ. of Idaho, 60 p.

Doe, B. R., and Delevaux, M. H., 1983, Lead isotope characteristics of ore systems in central Idaho, in Fisher, F. S., and Johnson, K. M., compilers, Abstracts of the symposium on the geology and mineral deposits of the Challis 1° X 2° quadrangle, Idaho: U. S. Geological Survey Open-File Report 83-836, p 11-12.

Doler, R. E., 1978, A review of the Bullion Lode property, Idaho County, Idaho: Unpublished report for the Bullion Lode Mining Company, Spokane, Washington.

EG & G geoMetrics, 1980, Aerial gamma ray and magnetic survey, Idaho project, Hailey, Idaho Falls, Elk City quadrangles of Idaho/Montana and Boise quadrangle, Oregon/Idaho, Final Report, vols. I and II: (Contract DE-AC-13-76=GJO 1664, Subcontract 79-323-S), 1980, U. S. Department of Energy Report GJBX-10 (80), Available through the U.S. Geological Survey Branch of Open File Services, Denver, Colorado, 212 p.

Eilertsen, D. E., and Lamb, F. D., 1956, A comprehensive report of exploration by the Bureau of Mines for thorium and radioactive black mineral deposits: U. S. Bureau of Mines RME-3140, issued by the U. S. Atomic Energy Commission Tech. Info. Service Extension, Oak Ridge, Tenn., 46 p.

Ekren, E. B., 1981, Van Horn Peak - a welded tuff vent in central Idaho, in Tucker, T. E., ed., Montana Geological Society Field Conference and Guidebook to Southwest Montana: p. 311-315.

_____, 1983, The Challis volcanic field, in Fisher, F. S., and Johnson, K. M., compilers, Abstracts of the symposium on the geology and mineral deposits of the Challis 1° X 2° quadrangle, Idaho: U. S. Geological Survey Open-File Report 83-836, p. 4.

Eldridge, G. H., 1895, A geological reconnaissance across Idaho: Sixteenth annual report of the U. S. Geological Survey, Part II, Papers of an economic character: p. 211-276.

Esparza, L. E., Olson, J. E., and Willett, S. W., 1984, Mineral investigation of the Gospel-Hump Wilderness, Idaho County, Idaho: U. S. Bureau of Mines Open-File Report MLA 2-84, 24 p.

Fenne, F. K., 1977, Geology and mineral deposits of the central part of the Parker Mountain mining district, Lemhi County, Idaho: unpublished M.S. thesis, Univ. of Idaho, 82 p.

Fisher, F. S., McIntyre, D. H., and Johnson, K. M., compilers, 1983, Geologic map of the Challis 1° X 2° quadrangle, Idaho: U. S. Geological Survey Open-File Report 83-523, scale 1:250,000, with text.

Fisher, F. S., and Johnson, K. M., compilers, 1983, Abstracts of the symposium on the geology and mineral deposits of the Challis 1° X 2° quadrangle, Idaho: U. S. Geological Survey Open-File Report 83-836, 15 p.

Fisher, F. S., 1983, Spatial and temporal distribution of selected mineral resources in the Challis quadrangle, Idaho, in Fisher, F. S., and Johnson, K. M., compilers, Abstracts of the symposium on the geology and mineral deposits of the Challis 1° X 2° quadrangle, Idaho: U. S. Geological Survey Open-File Report 83-836, p. 14.

Geodata International, Inc., Aerial radiometric and magnetic survey, Challis quadrangle Contract DE-AC13-76-GJO 1664, Subcontract SB0308 (A) 77-C-508), 1979, U. S. Department of Energy Report GJBX-156 (79), Available through the U.S. Geological Survey Branch of Open File Services, Denver, Colorado, 53 p.

Greenwood, W. R., and Morrison, D. A., 1973, Reconnaissance geology of the Selway-Bitterroot Wilderness area: Idaho Bureau of Mines and Geology Pamph. 154, 30 p.

Hall, B. S., 1980, Petrography and geochemistry of a part of the Painted Rocks pluton, Idaho County, Idaho: unpublished M.S. thesis, Eastern Washington University, 94 p.

Hall, W. E., 1983, Controls and characteristics of mineralization in middle and upper Paleozoic rocks in central Idaho, in Fisher, F.S., and Johnson, K. M., compilers, Abstracts of the symposium on the geology and mineral deposits of the Challis 1° X 2° quadrangle, Idaho: U. S. Geological Survey Open-File Report 83-836, p. 8-9.

Hardyman, R. F., 1981, Twin Peaks caldera of central Idaho, in Tucker, T. E., ed., Montana Geological Soc. Field Conference and Guidebook to southwest Montana: p. 317-322.

_____, 1983, The Twin Peaks caldera and associated ore deposits, in Fisher, F. S., and Johnson, K. M., compilers, Abstracts of the symposium on the geology and mineral deposits of the Challis 1° X 2° quadrangle, Idaho: U. S. Geological Survey Open-File Report 83-836, p. 6-7.

Hardyman, R. F., and Fisher, F. S., 1983, Mineralization and rhyolite intrusions in the Challis volcanic field, in Fisher, F. S., and Johnson, K. M., compilers, Abstracts of the symposium on the geology and mineral deposits of the Challis 1° X 2° quadrangle, Idaho: U. S. Geological Survey Open-File Report 83-836, p. 11.

Hawkes, H. E., 1952, Geochemical prospecting in the Blackbird cobalt district, Idaho: Geol. Soc. America Bull., v. 63, no. 12, p. 1260.

Hobbs, S. W., 1983a, Pre-Tertiary sedimentary terranes of the Bayhorse area--Challis 1° X 2° quadrangle, in Fisher, F. S., and Johnson, K. M., compilers, Abstracts of the symposium on the geology and mineral deposits of the Challis 1° X 2° quadrangle, Idaho: U. S. Geological Survey Open-File Report 83-836, p. 4-5.

_____, 1983b, Structural and stratigraphic controls of ore deposits in the Bayhorse region, Custer County, Idaho, in Fisher, F. S., and Johnson, K. M., compilers, Abstracts of the symposium on the geology and mineral deposits of the Challis 1° X 2° quadrangle, Idaho: U. S. Geological Survey Open-File Report 83-836, p. 9.

Holloway, C. D., 1980, Petrology of the Eocene volcanic sequence, Nez Perce and Blue Joint Creeks, southern Bitterroot Mountains, Montana: unpublished M.S. thesis, University of Montana, 129 p.

Hughes, G. B., 1983, The basinal setting of the Blackbird district cobalt deposits, Idaho, in Proceedings of the Denver Regional Exploration Geologists Society Symposium, Genesis of Rocky Mountain ore deposits: Changes with time and tectonics, p. 21-28.

Hyndman, D. W., 1983, The Idaho batholith and associated plutons, Idaho and western Montana, in Roddick, J. A., ed., Circum-Pacific plutonic terranes: Geol. Soc. America Memoir 159, p. 213-240.

Innes, F. C., no date, Copper Cliffs Group: unpublished private report on file at Western Field Operations Center, U. S. Bureau of Mines, Spokane, Washington, 3 p.

Jacobs, M. H., 1902, Report of the mining districts of Idaho for the year 1902, 29 p.

James M. Montgomery, Inc., 1981, Stibnite Mining Project, Final Environmental Impact Statement: Consulting engineers report, 198 p.

Kauffman, A. J., Jr., and Baber, K. D., 1956, Potential of heavy-mineral-bearing alluvial deposits in the Pacific Northwest: U. S. Bureau of Mines Info. Circ. 7767, 36 p.

Kauffman, J. D., 1970, Steen Mine, Lemhi County, Idaho: unpublished data on file at Western Field Operations Center, U. S. Bureau of Mines, Spokane, Washington, 6 p.

Kiilsgaard, T. H., 1947, Geologic map of Valley County: Idaho Bureau of Mines and Geology Open-File map.

_____, 1954, Marygold property, Idaho County, Idaho: U. S. Department of the Interior, Office of Mineral Exploration Report DMEA-3210), unpublished data on file at Western Field Operations Center, U. S. Bureau of Mines, Spokane, Washington, 5 p.

Kiilsgaard, T. H., and Lewis, R. S., 1983, Cretaceous rocks of the Atlanta lobe of the Idaho batholith, in Fisher, F. S., and Johnson, K. M., compilers, Abstracts of the symposium on the geology and mineral deposits of the Challis 1° X 2° quadrangle, Idaho: U. S. Geological Survey Open-File Report 83-836, p. 3-4.

Kiilsgaard, T. H., and Bennett, E. H., 1983, Mineral deposits in the southern parts of the Atlanta lobe of the Idaho batholith and their relationship to Tertiary intrusive rocks and faulting, in Fisher, F.S., and Johnson, K. M., compilers, Abstracts of the symposium on the geology and mineral deposits of the Challis 1° X 2° quadrangle, Idaho: U. S. Geological Survey Open-File Report 83-836, p. 10-11.

Kirkpatrick, G. E., 1974, Geology and ore deposits of the Big Creek area, Idaho and Valley Counties, Idaho: unpublished M.S. thesis, Univ. of Idaho, 92 p.

Kline, M. H., Carlson, E. J., Storch, R. H., and Robertson, A, F., 1953, Bear Valley radioactive mineral placers, Valley County, Idaho: U. S. Bureau of Mines RME-3130, issued by the U. S. Atomic Energy Commission Tech. Info. Service Extension, Oak Ridge, Tenn., 23 p.

Knowles, C. R., 1975, Reconnaissance geochemistry of the Bighorn Crags: Idaho Bureau of Mines and Geology Info. Circ. 26, 24 p.

Knowles, C. R., and Bennett, E. H., 1978, A reconnaissance geochemical survey of the Warm Spring Creek-Loon Creek-Rapid River area, Custer and Lemhi Counties, Idaho: Idaho Bureau of Mines and Geology Open-File Report 78-3, 21 p.

Knowles, C. R., 1979, A geochemical survey of the upper part of Loon Creek, Custer County, Idaho: Idaho Bureau of Mines and Geology Open-File Report 79-6, 45 p.

Koschmann, A. H., and Bergendahl, M. H., 1968, Principal gold-producing districts of the United States: U. S. Geological Survey Prof. Paper 610, 283 p.

Larsen, E. S., and Livingston, D. C., 1920, Geology of the Yellow Pine cinnabar mining district, Idaho: U. S. Geological Survey Bull. 715, p. 73-83.

Lasmanis, R. L., 1981, West End gold deposit, Yellow Pine mining district, Idaho: paper presented at the 87th Annual Northwest Mining Association Convention, Spokane, Washington, December 3.

Leinart, P. M., and Salisbury, W. G., 1982, National uranium resource evaluation, Elk City quadrangle, Idaho and Montana: U. S. Department of Energy Report PGJ/F-065 (82), 128 p.

Lemmon, D. M., and Tweto, O. L., 1962, Tungsten in the United States (exclusive of Alaska and Hawaii): U. S. Geological Survey Mineral Investigations Resource Map MR-25, scale 1:3,168,000, with text.

Leonard, B. F., 1957, Geology of the Big Creek quadrangle, central Idaho: Geol. Soc. America Bull., v. 68, no. 12, p. 1867.

_____, 1965, Mercury-bearing antimony deposit between Big Creek and Yellow Pine, central Idaho: U. S. Geological Survey Prof. Paper 525-B, p. 23-28.

Leonard, B. F., Mead, C. W., and Conklin, Nancy, 1968, Silver-rich disseminated sulfides from a tungsten bearing quartz lode, Big Creek district, central Idaho: U. S. Geological Survey Prof. Paper 594-C, 24 p.

Leonard, B. F., 1983, Ore deposits related to the Thunder Mountain caldera complex, in Fisher, F. S., and Johnson, K. M., compilers, Abstracts of the symposium on the geology and mineral deposits of the Challis 1^{o} X 2^{o} quadrangle, Idaho: U. S. Geological Survey Open-File Report 83-836, p. 7-8.

Leszcykowski, A. M., Lowe, N. T., Ridenour, J., and Willett, S. W., 1983, Mines and prospects in the Sheep Mountain mining district, Custer County, Idaho: U. S. Bureau of Mines Open-File Report MLA 89-83, 13 p.

Lindgren, Waldemar, 1900, The gold and silver veins of Silver City, DeLamar, and other mining districts in Idaho: Twentieth annual report of the U. S. Geological Survey, Part III, p. 65-256.

_____, 1904, A geological reconnaissance across the Bitterroot Ranges and Clearwater Mountains in Montana: U. S. Geological Survey Prof. Paper 27, p. 99-102.

Lorain, S. H., and Metzger, O. H., 1938, Reconnaissance of placer mining districts in Idaho County, Idaho: U. S. Bureau of Mines Info. Circ. 7023, 93 p.

Lorain, S. H., 1938, Gold mining and milling in Idaho County: U. S. Bureau of Mines Info. Circ. 7039, 90 p.

_____, 1942, Reconnaissance report on tungsten prospects near Edwardsburg, Valley County, Idaho: unpublished report on file at Western Field Operations Center, U. S. Bureau of Mines, Spokane, Washington, 7 p.

Lowe, N. T., Willett, S. W., and Benjamin, D. A., 1983, Mines and prospects in the Seafoam mining district, Custer County, Idaho: U. S. Bureau of Mines Open-File Report MLA 87-83, 15 p.

Lund, Karen, Rehn, W. M., and Holloway, C. D., 1983a, Geologic map of the Blue Joint Wilderness Study Area, Ravalli County, Montana, and the Blue Joint Roadless Area, Lemhi County, Idaho: U. S. Geological Survey Miscellaneous Field Studies Map MF-1557B, scale 1:50,000.

Lund, Karen, Rehn, W. M., and Benham, J. R., 1983b, Mineral resource potential of the Blue Joint Wilderness Study Area, Ravalli County, Montana, and the Blue Joint Roadless Area, Lemhi County, Idaho: U. S. Geological Survey Miscellaneous Field Studies Map MF-1557A, scale 1:100,000.

Lund, Karen, Evans, K. V., and Esparza, L. E., 1983c, Mineral resource potential of the Special Mining Management Zone--Clear Creek, Lemhi County, Idaho: U. S. Geological Survey Miscellaneous Field Studies Map MF-1576-A, scale 1:50,000 with pamphlet, 9 p.

Luthy, S. T., 1981, Petrology of Cretaceous and Tertiary intrusive rocks, Red Mountain-Bull Trout Point area, Boise, Valley, and Custer Counties, Idaho: unpublished M.S. thesis, Univ. of Montana, 109 p.

_____, 1982, Tertiary extensional tectonics and plutonism in the Idaho batholith, northwest Sawtooth Range, Boise County, Idaho (abs.): Geological Society of America, Rocky Mountain Section, Abstracts with Programs, v. 14, no. 6, p. 320.

Mabey, D. R., 1983, Geophysical studies in the Challis 1° X 2° quadrangle, Idaho, in Fisher, F. S., and Johnson, K. M., compilers, Abstracts of the symposium on the geology and mineral deposits of the Challis 1° X 2° quadrangle, Idaho: U. S. Geological Survey Open-File Report 83-836, p. 5.

Madson, M. E., Karp, K. E., D'Andrea, R. F., Jr., and Morrison, B. C., 1983, Integration of NURE and other data sets, south-west Montana and northeast Idaho: An orientation study to characterize mineralized environments: Bendix Field Engineering Co., GJBX-10 (83), 44 p.

Maley, T. S., 1974, Structure and petrology of the lower Panther Creek area, Lemhi County, Idaho: unpublished Ph.D. thesis, Univ. of Idaho, 130 p.

Marvin, R. F., Tschanz, C. M., Mehnert, H. H., and Magnum, J., 1973, Late Cretaceous age for molybdenite mineralization in Custer County, Idaho: Isochron/West, no. 7, p. 1.

McIntyre, D. H., Hobbs, S. W., Marvin, R. F., and Mehnert, H. H., 1976, Late Cretaceous and Eocene ages for hydrothermal alteration and mineralization, Bayhorse district and vicinity, Custer County, Idaho: Isochron/West, no. 16, p. 11-12.

McIntyre, D. H., Marvin, R. F., Mehnert, H. H., Naeser, C. W., and Futa, K., 1978, Pre-tertiary volcanic rocks in central Idaho: Isochron/West, no. 23, p. 29-31.

McIntyre, D. H., Ekren, E. B., and Hardyman, R. F., in press, Stratigraphic and structural framework of the Challis volcanics in the eastern half of the Challis 1° X 2° quadrangle, in Cenozoic geology of Idaho: Idaho Bureau of Mines and Geology.

McIntyre, D. H., and Johnson, K. M., 1983, Epithermal gold-silver mineralization related to volcanic subsidence in the Custer graben, Custer County, Idaho, in Fisher, F. S., and Johnson, K. M., compilers, Abstracts of the symposium on the geology and mineral deposits of the Challis 1° X 2° quadrangle, Idaho: U. S. Geological Survey Open-File Report 83-836, p. 8.

Millard, H. T., Rehn, W. M., Coxe, B. W., and Lund, Karen, 1982, Uranium and thorium data from water and stream sediments of the Blue Joint Wilderness Study Area, Ravalli County, Montana, and the Blue Joint Roadless Area, Lemhi County, Idaho: U. S. Geological Survey Open-File Report 81-1045, 18 p.

Mitchell, V. E., and Bennett, E. H., compilers, 1979, Geologic map of the Elk City quadrangle, Idaho: Idaho Bureau of Mines and Geology Geologic Map Series, scale 1:250,000.

Mitchell, V. E., Strowd, W. B., Hustedde, G. S., and Bennett, E. H., 1981a, Mines and prospects of the Challis quadrangle, Idaho: Idaho Bureau of Mines and Geology Mines and Prospects Map Series, 47 p.

_____, 1981b, Mines and prospects of the Elk City quadrangle, Idaho: Idaho Bureau of Mines and Geology Mines and Prospects Map Series, 72 p.

Modreski, P. J., 1983, Cobalt in Precambrian rocks of central Idaho, in Fisher, F. S., and Johnson, K. M., compilers, Abstracts of the symposium on the geology and mineral deposits of the Challis 1° X 2° quadrangle, Idaho: U. S. Geological Survey Open-File Report 83-836, p. 13-14.

Mosier, E. L., Pawlowski, M. R., Mutschler, F. E., Rehn, W. M., Lund, K. I., Coxe, B. W., and Yeoman, R. O., 1982a, Analyses of rocks and stream sediment from the Magruder Corridor Roadless Area, Idaho County, Idaho: U. S. Geological Survey Open-File Report 81-0891, 139 p.

Mosier, E. L., Rehn, W. M., Lund, Karen, Holloway, C. D., Coxe, B. W., and Yeoman, R. O., 1982b, Analyses of rocks and stream sediments from the Blue Joint Wilderness Study Area, Ravalli County, Montana, and the Blue Joint Roadless Area, Lemhi County, Idaho: U. S. Geological Survey Open-File Report 81-1212, 166 p.

National Oceanographic and Atmospheric Administration, 1974, Climates of the States: vol. II--Western States including Alaska and Hawaii, p. 481-975.

Olson, H. J., 1968, The geology and tectonics of the Idaho porphyry belt from the Boise Basin to the Casto quadrangle: unpublished Ph.D. dissertation, Univ. of Arizona, 154 p.

Onasch, C. M., 1979, Multiple folding along the western margin of the Idaho batholith in the Riggins, Idaho, area: Northwest Geology, v. 8, p. 95-100.

Prater, L. S., 1957, Black sands: Idaho Bureau of Mines and Geology Info. Circ. 1, 16 p.

Purdue, G. L., 1975, Geology and ore deposits of the Blackbird district, Lemhi County, Idaho: unpublished M.S. thesis, Univ. of New Mexico, 49 p.

Rann, J. E., 1979, The geology of Meyers Cove area, Lemhi County, Idaho: unpublished M.S. thesis, Univ. of Idaho, 111 p.

Reed, J. C., Jr., 1937, Geology and ore deposits of the Warren mining district, Idaho County, Idaho: Idaho Bureau of Mines and Geology Pamph. 45, 64 p.

_____, 1939, Geology and ore deposits of the Florence mining district, Idaho County, Idaho: Idaho Bureau of Mines and Geology Pamph. 46, 64 p.

_____, 1942, Veins in the Warren district, Idaho, in Newhouse, W. H., ed., Ore deposits as related to structural features, chapt. IV, part II: Princeton, New Jersey, Princeton Univ. Press, p. 175.

Reed, G. C., and Herdlick, J. A., 1947, Blackbird cobalt deposits, Lemhi County, Idaho: U. S. Bureau of Mines Rept. of Invest. 4012, 14 p.

Rember, W. C., and Bennett, E. H., compilers, 1979, Geologic map of the Challis quadrangle, Idaho: Idaho Bureau of Mines and Geology Geologic Map Series, scale 1:250,000.

Reynolds, J. R., 1954, Yellowjacket placer area: unpublished report of preliminary investigation by the United States Department of the Interior, Bureau of Mines, for the Atomic Energy Commission, 10 p.

Ridenour, J., Willett, S. W., Miller, M. S., Lowe, N. T., Leszcykowski, A. M., and Benjamin, D. A., 1983, Mines and prospects in the Loon Creek mining district, Custer County, Idaho: U. S. Bureau of Mines Open-File Report MLA 88-83, 13 p.

Roberts, W. A., 1953, Metamorphic differentiates in the Blackbird mining district, Lemhi County, Idaho: Econ. Geology, v. 48, no. 6, p. 447-456.

Romischer, W. M., and Maclaren, D. R., 1959, Tinkers Pride, et al. claims, Blackbird mining district, Lemhi County, Idaho, Final report: U. S. Department of Interior, Office of Mineral Exploration Report DMEA-3739, unpublished data on file at Western Field Operations Center, U. S. Bureau of Mines, Spokane, Washington, 19 p.

Ross, C. P., 1927, Ore deposits in Tertiary lava in the Salmon River Mountains, Idaho: Idaho Bureau of Mines and Geology Pamph. 25, 21 p.

Ross, C. P., 1930a, Geology and ore deposits of the Seafoam, Alder Creek, Little Smoky, and Willow Creek mining districts: Idaho Bureau of Mines and Geology Pamph. 33, 26 p.

_____, 1930b, A graphic history of metal mining in Idaho, in Contributions to economic geology--1930, Part I: U. S. Geological Survey Bull. 821-A, p. 1-9.

_____, 1931, A classification of the lode deposits of south-central Idaho: Econ. Geology, v. 26, p. 169-185.

_____, 1933a, The lode deposits in the Boise Basin, Idaho: Econ. Geology, v. 28, no. 4, p. 329-343.

_____, 1933b, The ore deposits of Idaho in relation to structural and historical geology, in Ore deposits of the Western States (Lindgren Volume): Am. Inst. Min. Metall. Eng., p. 265-272.

_____, 1933c, The Thunder Mountain mining district, Valley County, Idaho: Econ. Geology, v. 28, no. 6, p. 587-600.

_____, 1934, Geology and ore deposits of the Casto quadrangle, Idaho: U. S. Geological Survey Bull. 854, 135 p.

_____, 1937, Geology and ore deposits of the Bayhorse region, Custer County, Idaho: U. S. Geological Survey Bull. 877, 161 p.

_____, 1941a, The metal and coal mining districts of Idaho, with notes on the nonmetallic mineral resources of the State: Idaho Bureau of Mines and Geology Pamph. 57, Part I, annotated bibliography, 109 p.

_____, 1941b, Mining districts of the State of Idaho: Idaho Bureau of Mines and Geology Pamph. 57, Part III (map), scale 1:500,000.

_____, 1963, Mining history of south-central Idaho: Idaho Bureau of Mines and Geology Pamph. 131, 29 p.

Rott, E. H., 1943, Report on Gold Mine Order L-208--its effect and accomplishments: unpublished report, Resources Section, War Production Board, 11 p.

Ruppel, E. T., 1975, Precambrian Y sedimentary rocks in east-central Idaho: U. S. Geological Survey Prof. Paper 889-A, p. 1-23.

Sahinen, U. M., 1957, Mines and mineral deposits, Missoula and Ravalli Counties, Montana: Montana Bureau of Mines and Geology Bull. 8, 63 p.

Savage, C. N., 1961a, Economic geology of central Idaho blacksand placers: Idaho Bureau of Mines and Geology Bull. 17, 160 p.

_____, 1961b, Metals from blacksands: selected technologic and economic data: Idaho Bureau of Mines and Geology Info. Circ. 10, 34 p.

Savage, C. N., 1970, Evaluation of minerals and mineral potential of the Salmon River drainage basin in Idaho: Idaho Bureau of Mines and Geology Pamph. 147, 64 p.

Schmidt, E. A., Broch, M. J., and White, R. O., 1982, Geology of the Thompson Creek molybdenum deposit, Custer County, Idaho, in Proceedings of the Denver Regional Exploration Geologists Society Symposium, Genesis of Rocky Mountain Ore Deposits: Changes with time and tectonics, p. 79-84.

Schrader, F. C., and Ross, C. P., 1925, Antimony and quicksilver deposits in the Yellow Pine district, Idaho: U. S. Geological Survey Bull. 780, p. 137-164.

Shannon, S. S., Jr., and Reynolds, S. J., 1975, A brief geological survey of the east Thunder Mountain mining district, Valley County, Idaho: Idaho Bureau of Mines and Geology Info. Circ. 29, 13 p.

Sheldon, G. L., 1912, The Yellow Jacket Mine, Idaho: Engineering and Mining Journal, v. 93, p. 221-222.

Shenon, P. J., and Reed, J. C., 1934, Geology and ore deposits of the Elk City, Orogrande, Buffalo Hump, and Ten Mile districts, Idaho County, Idaho: U. S. Geological Survey Circ. 9, 89 p.

Shenon, P. J., and Ross, C. P., 1936, Geology and ore deposits near Edwardsburg and Thunder Mountain, Idaho: Idaho Bureau of Mines and Geology Pamph. 44, 45 p.

Shenon, P. J., Full, R. P., Bauer, H. L., and Snyder, D. M., 1955, Geologic study of the Blackbird-Big Deer Creek area, Blackbird mining district, Lemhi County, Idaho: unpublished consultant report for Northfield Mines, Inc., 44 p.

Shockey, P. N., 1957, Reconnaissance geology of the Leesburg quadrangle, Lemhi County, Idaho: Idaho Bureau of Mines and Geology Pamph. 113, 42 p.

_____, 1963, Geology of the Lost Packer Mine: unpublished report for the Ivers Mining Co., 37 p.

Sibbett, B. S., 1976, Geology of the northeast part of the Loon Creek mining district, Custer County, Idaho: unpublished M.S. thesis, Univ. of Idaho, 111 p.

Simons, W. H., 1934, Thirty-sixth annual report of the mining industry of Idaho for the year 1934, 287 p.

Skipp, Betty, 1981, A synopsis of the structure and stratigraphy of south-central Idaho--contributions by the U. S. Geological Survey since 1975, in Tucker, T. E., ed., Montana Geological Society Field Conference and Guidebook to southwest Montana: p. 365-372.

Slovarp, E. P., 1942, Statement of facts as ~~the~~ to the location and nature of properties containing strategic minerals or metals: unpublished statement made to the U. S. Bureau of Mines, regarding the Central Galena Group, on file at Western Field Operations Center, U. S. Bureau of Mines, Spokane, Washington, 2 p.

Staley, W. W., 1946, Gold in Idaho: Idaho Bureau of Mines and Geology Pamph. 68, 32 p.

Stiles, C. A., 1976, Geology and alteration of the West Fork of Mayfield Creek Custer County, Idaho: unpublished M.S. thesis, Univ. of Idaho, p.

Storch, R. H., and Holt, D. C., 1963, Titanium placer deposits of Idaho: U. S. Bureau of Mines Rept. of Invest. 6319, 65 p.

Thayer, P. A., and Cook, J. R., 1980, Challis 1° X 2° NTMS area--data report, National Uranium Resource Evaluation program, hydrogeochemical and stream sediment reconnaissance: U. S. Department of Energy Report GJBX-91 (80), 45 p.

Thomson, F. A., and Ballard, S. M., 1924, Geology and gold resources of north central Idaho: Idaho Bureau of Mines and Geology Bull. 7, 127 p.

Thomson, F. A., 1924, Gold veins of sundry areas in the Idaho batholith: Eng. & Mining Jour., v. 118, no. 14, p. 533-540.

Treves, S. B., and Melear, J. D., 1953, The geology and ore deposits of the Seafoam mining district, Custer County, Idaho: Idaho Bureau of Mines and Geology Pamph. 96, 19 p.

Truesdell, D., Wegrzyn, R., and Dixon, M., 1977, Provenance of radioactive placers, Big Meadow area, Valley and Boise Counties, Idaho: U. S. Energy Research and Development Admin. Report GJBX-15 (77), 52 p.

Tschanz, C. M., Kiilsgaard, T. H., Seeland, D. A., Van Noy, R. M., Ridenour, J., Zilka, N. T., Federspiel, F. E., Evans, R. K., Tuchek, E. T., and McManan, A. B., 1974, Mineral resources of the eastern part of the Sawtooth National Recreation Area, Blaine and Custer Counties, Idaho: U. S. Geological Survey Open-File Report 74-100, 648 p.

Umpleby, J. B., 1913a, A preliminary account of the ore deposits of the Loon Creek district, Idaho, in Contributions to economic geology, 1911, Part I: U. S. Geological Survey Bull. 530, p. 66-74.

_____, 1913b, Some ore deposits in northwestern Custer County, Idaho: U. S. Geological Survey Bull. 539, 104 p.

_____, 1913c, Geology and ore deposits of Lemhi County, Idaho: U. S. Geological Survey Bull. 528, 182 p.

_____, 1915, Ore deposits in the Sawtooth quadrangle, Blaine and Custer Counties, Idaho: U. S. Geological Survey Bull. 580, p. 221-249.

Umpleby, J. B., and Livingston, D. C., 1920, A reconnaissance in south-central Idaho, embracing the Thunder Mountain, Big Creek, Stanley Basin, Sheep Mountain, and Seafoam districts, Idaho: Idaho Bureau of Mines and Geology Bull. 3, 31 p.

U. S. Bureau of Mines, 1943, Fluorite veins near Meyers Cove, Lemhi County, Idaho: War Minerals Report 145, 7 p.

_____, 1945, Meyers Cove fluorspar deposits, Gravel Range mining district, Lemhi County, Idaho: War Minerals Report 460, 11 p.

_____, 1983, MINSIM: A computer model for the economic evaluation of mineral operations: Technology News, No. 180, August 1983.

U. S. Bureau of Mines and U. S. Geological Survey, 1980, Principles of a resource/reserve classification for minerals: U. S. Geological Survey Circ. 831, 5 p.

U. S. Department of Energy, 1982a, Challis quadrangle residual intensity magnetic anomaly contour map: DOE, Grand Junction, Colorado, scale 1:250,000.

_____, 1982b, Elk City quadrangle residual intensity magnetic anomaly contour map: DOE, Grand Junction, Colorado, scale 1:250,000.

U. S. Geological Survey, Idaho Bureau of Mines and Geology, and Idaho Department of Reclamation, 1964, Mineral and water resources of Idaho: Idaho Bureau of Mines and Geology Special Report No. 1, 335 p.

Vhay, J. S., 1948, Cobalt-copper deposits in the Blackbird district, Lemhi County, Idaho: U. S. Geological Survey Strategic Minerals Inv. Prelim. Report 3-219, 26 p.

Wagstaff, D. A., 1979, The geology of the SW 1/4 of the Meyers Cove quadrangle, Lemhi County, Idaho: unpublished M.S. thesis, Univ. of Idaho, 101 p.

Webring, M. W., and Mabey, D. R., 1981, Principal facts for gravity stations in the Challis, Idaho, 1° X 2° quadrangle: U. S. Geological Survey Open-File Report 81-652, scale 1:250,000.

Weis, P. L., Schmitt, L. J., Jr., and Tuchek, E. T., 1972, Mineral resources of the Salmon River Breaks Primitive Area, Idaho: U. S. Geological Survey Bull. 1353-C, 91 p.

Wells, J. H., 1973, Placer examination, principles and practice: U. S. Dept. of the Interior, Bureau of Land Management Tech. Bull. 4, 209 p.

Wells, M. W., 1961, Rush to Idaho: Idaho Bureau of Mines and Geology Bull. 19, 57 p.

White, D. E., 1940a, Antimony deposits of a part of the Yellow Pine district, Valley County, Idaho: U. S. Geological Survey Bull. 922-I, p. 247-279.

_____, 1940b, Geologic map of the Yellow Pine area, Valley County, Idaho: U. S. Geological Survey Strategic Min. Inv. Prelim. Map, scale 1:48,000.

Woodward, G. E., and Luff, Paul, 1943, Gold, silver, copper, lead, and zinc in Idaho, in Needham, C. E., ed., U. S. Bureau of Mines Minerals Yearbook-1942, p. 363-387.

Yinger, M. A., 1976, Geology of the eastern part of the Loon Creek mining district, Custer County, Idaho: unpublished M.S. thesis, Univ. of Idaho, 103 p.

APPENDIX--COMMODITY HIGHLIGHTS

[Source: U.S. Bureau of Mines Mineral Commodity Summaries, 1985.]

Commodity	Domestic mine production	Apparent consumption	Units	Major import sources	Net import reliance (percent)	Average 1984 domestic price (dollars)	Price unit	Expected U.S. demand through 1990	Major uses
Metallic commodities									
Gold	2,300,000	4,800,000	Troy ounces	Canada Switzerland Uraguay	16	$365.00	Troy ounce	Annual increase rate of 2.0%	Jewelry and arts, industrial (mainly electronic), dental
Silver	44,000,000	170,000,000	Troy ounces	Canada Mexico Peru United Kingdom	61	$8.25	Troy ounce	Annual increase rate of 2.2%	Photography, electrical and electronic products, sterlingware, electroplated ware, jewelry, brazing alloys, and solders
Cobalt	450	9,250	Short tons	Zaire Zambia Canada Japan	95	$12.50	Pound	Annual increase rate of 3%	Superalloys, magnetic materials, driers, catalysts, metalcutting tools
Copper	1,050,000	2,100,000 2/	Metric tons	Chile Canada Peru Zambia	21	$ 0.66	Pound	Annual increase rate of 1.8%	Building construction, electrical and electronic products, industrial machinery and equipment, transportation
Lead	340,000	1,030,000	Metric tons	Peru Honduras Canada Australia Mexico	18	$0.22	Pound	Annual increase rate of 1.3%	Batteries, gasoline additives, construction paint, ammunition, electrical, ceramics, glass
Zinc	265,000	1,030,000	Metric tons	Canada Peru Mexico Spain Australia	67	$0.48	Pound	Annual increase rate of 2.2%	Construction materials, transportation, machinery, electrical

Nonmetallic commodities									
Fluorspar	70,000 3/	800,000	Short tons	Mexico Republic of S. Africa China Italy	91	$173.00 4/ $125.00 5/	Short ton	Annual increase of 2.7%	Hydrofluoric acid (aluminum, flourochemical, and uranium industries), steelmaking, glass manufacture, welding rod, coatings, enamels
Zeolites	6/	6/	6/	6/	6/	$200- 7/ $6000	Short ton	6/	Radioactive waste disposal, sewage treatment, natural gas purification, coal gasification, catalyst preparation, cation filters

e/ Estimated
1/ Defined as imports-exports + adjustments for government and industry stock changes.
2/ Defined as primary refined production + copper refined from old scrap and copper recovered in alloys from old scrap + refined imports - refined exports ± changes in refined stocks.
3/ Finished (all grades); shipments
4/ Acid grade.
5/ Metallurgical grade.
6/ Not available; U.S. Bureau of Mines does not track these industrial minerals.
7/ Clinoptolite (low) to chabazite and mordenite (high).

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